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1950/51

# BULLETIN OF THE UNIVERSITY OF

1950-51

## GRADUATE SCHOOL


JUNE 1950

University of New Hampshire  
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# *BULLETIN of the University of New Hampshire*

*Published monthly by the University of New Hampshire, Durham, N. H.  
Entered as second-class matter, August 5, 1907 at the Post Office at  
Durham, N. H., under the Act of Congress of July 16, 1894.*



## THE UNIVERSITY BULLETIN INCLUDES:

The Catalogue Issue of the University

The Report of the President Issue

The Financial Report Issue

The Catalogue Issue of the Summer Session

The Catalogue Issue of the Graduate School

*and other publications of the University of New Hampshire*

## CORRESPONDENCE

Prospective graduate students are invited to correspond with University officials as follows:

Dean of the Graduate School relative to application forms; The Graduate School Bulletin relative to admissions, graduate status, graduate scholarships, transfer of credits, and programs of study.

Chairmen of Departments for further information and guidance relative to departmental course offerings, individual programs of study, and graduate assistantships.

Director of the Summer Session for information on summer course offerings.

University Alumni Secretary for information concerning the Alumni Association.

University Recorder for transcripts of grades earned at the University of New Hampshire.

Director of Placement for information concerning employment opportunities.

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# CALENDAR

1950

JULY						
S	M	T	W	T	F	S
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
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30	31					

AUGUST						
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SEPTEMBER						
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OCTOBER						
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NOVEMBER						
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1951

JANUARY							JULY						
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FEBRUARY							AUGUST						
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APRIL							OCTOBER						
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MAY							NOVEMBER						
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JUNE							DECEMBER						
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1952

JANUARY						
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JUNE						
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# UNIVERSITY OF NEW HAMPSHIRE CALENDAR

1950-51

## 1950 SUMMER SESSION

July 5	Wednesday	Summer Session Registration
July 8, 15	Saturdays	Classes meet to make up days lost on July 3 and 4
Aug. 11	Friday	Summer Session closes

## FIRST SEMESTER 1950-51

Sept. 19	Tuesday	Orientation Week begins
Sept. 25	Monday	Registration Day
Sept. 26	Tuesday	Classes begin at 8:00 a.m.
Oct. 10	Tuesday	University Day — no afternoon classes
Nov. 11	Saturday	Armistice Day, classes end, 11:00 a.m.
Nov. 14	Tuesday	Mid-Semester Reports to be filed, 5:00 p.m.
Nov. 22	Wednesday-	Thanksgiving Recess — Wednesday, 12:00 noon, to
Nov. 27	Monday	Monday, 8:00 a.m.
Dec. 16	Saturday	Christmas Recess begins at 12:00 noon

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Jan. 2	Tuesday	Christmas Recess ends at 8:00 a.m.
Jan. 20	Saturday	Preparation Day, no classes
Jan. 22-	Monday-	Examination Period
Feb. 2	Friday	

## SECOND SEMESTER

Feb. 5	Monday	Classes begin at 8:00 a.m.
Feb.	Friday-	Winter Carnival — no classes Friday, 1:00 p.m., to
	Saturday	Monday, 8:00 a.m.
March 13	Tuesday	Town Meeting, classes excused 10:00 a.m. to 1:00 p.m.
March 20	Tuesday	Mid-Semester Reports to be filed, 5:00 p.m.
March 24	Saturday	Spring Recess begins at 12:00 noon
April 2	Monday	Spring Recess ends at 8:00 a.m.
May 5	Saturday	Mothers' Day, classes end 11:00 a.m.
May 26	Saturday	Preparation Day, no classes
May 28	Monday	Examinations begin
May 30	Wednesday	Memorial Day, holiday
June 9	Saturday	Examinations end
June 10	Sunday	Commencement
June 16-17	Saturday-	Alumni Weekend
	Sunday	

## BOARD OF TRUSTEES

HIS EXCELLENCY, GOVERNOR SHERMAN ADAMS, A.B., LL.D., *ex officio*

PERELEY I. FITTS, B.S., COMMISSIONER OF AGRICULTURE, *ex officio*

PRESIDENT ARTHUR S. ADAMS, SC.D., *ex officio*

†HARRY D. SAWYER	Woodstock, N. H.
September 15, 1926 to April 27, 1950	

FRANK W. RANDALL, B.S., LL.D., <i>President</i>	Portsmouth, N. H.
July 1, 1936 to June 30, 1952	

ARTHUR E. MOREAU, A.M.	Manchester, N. H.
September 14, 1944 to June 30, 1951	

LAURENCCE F. WHITTEMORE, M.A.	Pembroke, N. H.
September 14, 1944 to June 30, 1952	

MARY S. BROWN	Center Sandwich, N. H.
December 20, 1944 to June 30, 1951	

AUSTIN I. HUBBARD, B.S., <i>Secretary</i>	Walpole, N. H.
December 20, 1944 to June 30, 1953	

*ALBERT S. BAKER, B.S.	Concord, N. H.
July 1, 1948 to June 30, 1952	

*ANNA L. PHILBROOK, M.D.C.M.	Dunbarton, N. H.
July 1, 1949 to June 30, 1951	

ERNEST W. CHRISTENSEN, B.S.	Dover, N. H.
July 1, 1949 to June 30, 1953	

MAURICE F. DEVINE, LL.B., LL.D.	Manchester, N. H.
December 21, 1949 to June 30, 1954	

IDA K. SAWYER	Woodstock, N. H.
May 16, 1950 to June 30, 1950	

GEORGE L. FRAZER	Monroe, N. H.
July 1, 1950 to June 30, 1954	

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†Deceased

\*Elected by Alumni



107. TECHNICAL CONTROL. Chemical and bacteriological laboratory methods used in the technical control of milk and milk products. Mr. Moore. *Prereq.*: D.H. 30 or equivalent. 2 lec.; 1 lab.; 3 cr.

109, 110. SPECIAL PROBLEMS IN DAIRY MANUFACTURE. Detailed study of some special phase of dairy manufacturing. Mr. Moore. *Prereq.*: A major in Dairy Husbandry. Conferences and special assignments. 3 cr.

111, 112. SPECIAL PROBLEMS IN DAIRY PRODUCTION. Study of some special phase of breeding or feeding as related to dairy-herd management. Mr. Morrow, Mr. Keener. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry. Conferences and special assignments. 3 cr.

## BACTERIOLOGY

LAWRENCE W. SLANETZ, *Chairman*

Students majoring in Bacteriology are expected to have had preparation in the biological and physical sciences and in the basic courses in Bacteriology. A thesis is required and a candidate for the Master's Degree shall pass an oral examination covering his graduate courses and thesis.

53. IMMUNOLOGY AND SEROLOGY. The theories of infection and immunity; production of vaccines; toxins, and antisera; serological techniques for disease diagnosis and identification of bacteria, including agglutination, precipitin, and complement fixation tests. Mrs. Bartley. *Prereq.*: Bact. 8. 2 lec.; 2 lab.; 4 cr.

55, 56. PROBLEMS IN BACTERIOLOGY. Special problems, depending upon the training and desire of the student. Elective only upon consultation. Mr. Slanetz and members of the staff. Credits to be arranged.

57, 58. BACTERIOLOGY SEMINAR. Reports and discussions on current literature and recent developments in Bacteriology. Mr. Slanetz and staff. *Prereq.*: Bact. 2 or 8 and consent of instructor. 1 rec.; 1 cr.

101. PHYSIOLOGY OF BACTERIA. A study of the growth, nutrition, and metabolism of bacteria; influence of physical and chemical environment on growth; bacterial enzymes, protein decomposition and fermentation. Mr. Howe. *Prereq.*: Organic Chemistry and Bact. 2 or 8, or equivalent. 3 lec.; 3 cr.

104. **SYSTEMATIC BACTERIOLOGY.** A study of procedures and methods for the classification of bacteria; review of modern systems of classification. Mr. Slanetz. *Prereq.:* Bact. 2 or 8 or equivalent. 2 lec.; 1 lab.; 3 cr.

108. **PATHOGENIC AND DIAGNOSTIC BACTERIOLOGY.** A study of the morphological, cultural, biochemical, serological, and pathogenic characteristics of microorganisms causing human and animal diseases. Students will be expected to perform the laboratory procedures for the diagnosis of various infectious diseases. Mr. Slanetz, Mrs. Bartley, Mr. Howe. *Prereq.:* Bact. 1 or equivalent. 2 lec.; 2 lab.; 4 cr.

109, 110. **BACTERIOLOGY SEMINAR.** Reports and discussions on bacteriological literature and recent developments in bacteriology. Mr. Slanetz and staff. *Prereq.:* Permission of the instructor. 1 rec.; 1 cr.

153. **ADVANCED IMMUNOLOGY AND SEROLOGY.** The theories of infection and immunity; production of vaccines; toxins, and antiserums; serological techniques for disease diagnosis and identification of bacteria, including agglutination, precipitin, and complement fixation tests. Students will be assigned special problems on certain phases of the lecture or laboratory work. Mrs. Bartley. *Prereq.:* Bact. 8. 2 lec.; 2 lab.; 4 cr.

## BIOLOGY

GEORGE M. MOORE, *Chairman of Committee*

Students who wish to secure the Master's Degree in Biology must have completed an undergraduate major in Biology or in some field of the biological sciences. Suitable training in the physical sciences is also necessary. Students lacking undergraduate training in any of the fields of the biological sciences may be required to complete certain courses in these fields which do not carry graduate credit before they are admitted to candidacy for a degree.

Graduate work in Biology is under the direction of a committee consisting of the Chairmen of the Departments of Bacteriology, Botany, Entomology, and Zoology. This committee shall determine, in light of the student's objectives, the courses and requirements to be met by the candidate. Candidates for the Master's Degree in Biology shall pass an oral examination covering their general preparation in the field, and the thesis.

**THESIS REQUIREMENTS.** A thesis will generally be required of a student securing the Master's Degree in Biology. The number of

thesis credits will be six. In certain cases, where it seems appropriate in the light of the student's educational objectives, the thesis requirement may be waived. Permission to waive the thesis requirement will be granted on recommendation of the committee mentioned above. When permission is granted to waive the thesis requirement, the student shall present two graduate credits in Seminar (Bact. 57, 58; or Zool. 87, 88).

91. BIOLOGY-EDUCATION. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY. Objectives and methods of teaching; the selection and organization of materials; the preparation of visual aids; the setting up of aquaria and other projects. Some instruction in the preparation of biological materials for the classroom; instruction in making models and aquaria. The use of the field trip as a tool in teaching high-school biology. *Prereq.*: Two years of biological sciences and Ed. 61. 2 rec.; 1 lab.; or field trip; 3 cr.

95. BIOLOGY-EDUCATION. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY. Objectives and methods of teaching; the selection and organization of materials; the preparation of visual aids; the setting up of aquaria and other projects. Some instruction in the preparation of biological materials for the classroom; instruction in making models and aquaria. The use of the field trip as a tool in teaching high-school biology. This course is acceptable for Biology-Education 91; however, students who already have credit for Biology-Education 91 will not receive credit for this course. Mr. Davis. *Prereq.*: Either 1) Two years of biological science and Ed. 61, or 2) A year of teaching of high-school biology. 2 rec.; 2 lab.; or field trip; 4 cr. (*Offered in summer only.*)

For listings of other courses see: Bacteriology, Botany, Entomology, and Zoology.

## BOTANY

ALBION R. HODGDON, *Chairman*

Students who desire a Master's Degree in Botany are expected to have had adequate preparation in basic botany courses and in the physical sciences. The candidate will be required to pass an oral examination and to prepare a thesis. Thesis credits may be from 6-10 depending on the research problem involved. The subject-matter fields for graduate study in Botany are: Systematic Botany and Plant Ecology, Mr. Hodgdon; Plant Physiology, Mr. Dunn; Plant Morphology and Anatomy and Cytology, Miss Nast; Plant Pathology and Mycology, Mr. Richards.

51. PLANT PATHOLOGY. The nature of disease in plants, the etiology, symptomatology, and classification of plant diseases. Mr. Richards. *Prereq.*: Bot. 1 or Bot. 3. 1 lec.; 2 lab.; 3 cr.

52. PRINCIPLES OF PLANT-DISEASE CONTROL. Exclusion, eradication, protection, and immunization, and the specific, practical methods used to control plant diseases. Mr. Richards. *Prereq.*: Bot. 1 or Bot. 3 1 lec.; 2 lab.; 3 cr. (Not given in 1950-51.)

55. ADVANCED SYSTEMATIC BOTANY. The principles and laws of plant classification and nomenclature; study of plant families, field, and herbarium work. Mr. Hodgdon. *Prereq.*: Bot. 6. Hours to be arranged. 4 cr.

57, 58. PROBLEMS IN (a) SYSTEMATIC BOTANY, (b) PLANT PHYSIOLOGY, (c) PLANT PATHOLOGY, and (d) PLANT ANATOMY AND CYTOLOGY. Elective only upon consultation with Chairman of Department. Mr. Hodgdon, Mr. Dunn, Mr. Richards, Miss Nast. Hours to be arranged. 2 to 6 cr.

102. ADVANCED PLANT ECOLOGY. Requirements for growth; specialization and adaptation; geographic and physiographic relations. Regional floras. Interpretation and classification of habitat. Special problems are assigned. Mr. Hodgdon. Incidental lectures, laboratory, and field work. 4 cr.

104. HISTOLOGICAL TECHNIQUES. A methods course in embedding, sectioning, and staining plant tissues, and preparation of toto mounts. Miss Nast. *Prereq.*: Bot. 1 or Bot. 3. 3 cr.

105. ADVANCED PLANT PHYSIOLOGY. Absorption, translocation, transpiration, and excretion of water, and effect of environmental factors upon these phenomena; permeability and mineral nutrition. Mr. Dunn. *Prereq.*: Bot. 40 or equivalent, or adequate preparation in the physical sciences. Conferences, laboratory, and assigned reading. 3 cr. (*Note*: Both Bot. 105 and 106 should be taken for a complete covering of the subject.)

106. ADVANCED PLANT PHYSIOLOGY. Photosynthesis; respiration, growth, reproduction, and movement; effect of environmental factors on these phenomena. Mr. Dunn. *Prereq.*: Bot. 40 or equivalent, or adequate preparation in the physical sciences. Conferences, laboratory, and assigned reading. 3 cr.

107, 108. PROBLEMS IN (a) SYSTEMATIC BOTANY, (b) PLANT PHYSIOLOGY, (c) PLANT PATHOLOGY, and (d) PLANT ANATOMY AND CYTOLOGY. Elective only upon consultation with Chairman of Department. Mr. Hodgdon, Mr. Dunn, Mr. Richards, Miss Nast. Hours to be arranged. 2 to 6 credits.

112. MYCOLOGY. Studies of the parasitic and saprophytic fungi, their growth, reproduction, and identification. Mr. Richards. Laboratory and assigned reading. 1 lec.; 2 lab.; 3 cr. (Not given in 1950-51).

# CHEMICAL ENGINEERING

OSWALD T. ZIMMERMAN, *Chairman*

To be admitted as a candidate for the degree of Master of Science in Chemical Engineering an applicant shall be expected to have completed a course of study substantially equivalent to that required for the degree of Bachelor of Science in Chemical Engineering in this University. However, students with good undergraduate records but with deficiencies in certain areas may be admitted on condition that they complete specified courses without credit to make up for their deficiencies.

71-72. UNIT PROCESSES. The important inorganic and organic industrial chemical processes from the point of view of the basic chemical reactions and physical operations involved. Mr. Zimmerman. *Prereq.*: Chem. 22. 2 lec.; 2 cr.

74-75. UNIT OPERATIONS. The theory and practice of the fundamental chemical engineering unit operations, including flow of fluids, flow of heat, evaporation, distillation, drying, filtration, gas absorption, extraction, humidification and air conditioning, crystallization, crushing and grinding, and size separation. Mr. Zimmerman. *Prereq.*: Ch. E. 71 and Chem. 83. 3 lec.; 3 cr.

76. CHEMICAL ENGINEERING ECONOMICS. The economic factors involved in industrial chemical processes and the application of economic balances to the design and selection of chemical engineering equipment. Mr. Zimmerman. *Prereq.*: Ch. E. 75, 77. 3 lec.; 3 cr.

77. UNIT OPERATIONS LABORATORY. Experiments based upon the unit operations are performed on typical chemical engineering equipment. Mr. Zimmerman. *Prereq.*: Chem. 74, 84. 3 lab.; 3 cr.

78. CHEMICAL PLANT DESIGN. The design and layout of chemical plants and equipment. The assigned problems are of a practical nature, such as the manufacture of some chemical product, and their solution will include the design or selection of all equipment and drawings of equipment, plant, and layout. Mr. Zimmerman. *Prereq.*: Ch. E. 75, 77. 3 lab.; 3 cr.

135. UNIT OPERATIONS — FLUID FLOW, HEAT FLOW, AND EVAPORATION. An advanced course dealing with the fundamental theory and applications of these operations. Mr. Zimmerman. *Prereq.*: Ch. E. 74 or equivalent. 2 lec. or rec.; 2 cr.

136. UNIT OPERATIONS — DIFFUSION OPERATIONS. An advanced study of the principles of diffusion and their application to

the unit operations of distillation, absorption, drying, humidification, and extraction. Mr. Zimmerman. *Prereq.*: Ch. E. 75 or equivalent. 2 lec. or rec.; 2 cr.

137, 138. UNIT PROCESSES. A study of the more recent developments in pyrolysis, oxidation, chlorination, nitration, and other unit processes. *Prereq.*: Ch. E. 72, Chem. 48, and Chem. 84, or equivalents. 2 lec.; 2 cr.

139. CHEMICAL ENGINEERING THERMODYNAMICS. A study of recent developments in thermodynamics with particular emphasis on low-temperature and high-pressure processes. *Prereq.*: Ch. E. 79 or equivalent. 2 lec.; 1 rec.; 3 cr.

141, 142. PROBLEMS IN CHEMICAL ENGINEERING. Independent investigations in some phase of chemical engineering. Mr. Zimmerman. *Prereq.*: Special permission. Credits to be arranged.

## CHEMISTRY

HAROLD A. IDDLES, *Chairman*

Admission to graduate study in Chemistry requires the usual undergraduate courses in general chemistry, analytical chemistry, organic chemistry, and physical chemistry with the supporting courses in mathematics and physics.

55, 56. STRUCTURAL AND THEORETICAL PROBLEMS OF MODERN ORGANIC CHEMISTRY. An intensive review of the methods of preparation and reactions of the principal classes of organic compounds. Emphasis is on the working of assigned problems. The electron theory of organic chemistry is used to correlate the chemical behavior of unsaturated compounds, free radicals, and other classes. Mr. Atkinson. *Prereq.*: Chem. 48 or 54. 3 lec.; 3 cr.

62. ADVANCED METHODS OF QUANTITATIVE ANALYSIS. The theory and technique of special and recently developed methods of analysis such as colorimetry, turbidimetry, potentiometry, and spectrography. Sufficient experience is obtained to allow the development of considerable skill in even the more complex methods. Mr. Millard. *Prereq.*: Chem. 22. 2 lec.; 2 lab.; 4 cr.

82. PRE-MEDICAL AND PRE-DENTAL PHYSICAL CHEMISTRY. Kinetic theory of gases; quantitative laws for behavior of matter in the gas, liquid, and solid phases; valence and the chemical bond; radioactivity; atomic structure and valence; laws of solution; homogeneous and heterogeneous equilibrium; colloids; electrochemistry. Mr. O'Loane. *Prereq.*: Chem. 2 or 4, Phys. 2, Math. 16. 3 lec.; 3 cr.

83-84. ELEMENTARY PHYSICAL CHEMISTRY. The properties of gases, liquids and solids; thermochemistry and thermodynamics; solutions, chemical equilibria, reaction rates, conductance and electromotive force. Mr. O'Loane. *Prereq.*: Chem. 22, Math. 18, Phys. 22. 3 lec.; 2 lab.; 5 cr.

85, 86. ADVANCED PHYSICAL CHEMISTRY. A review of selected topics in elementary physical chemistry followed by a study of the structure and properties of matter. *Prereq.*: Chem. 84 or equivalent. 3 lec.; 3 cr.

87, 88. CHEMICAL LITERATURE AND SEMINAR. Use of the chemical library; student reports on topics of interest. Mr. Atkinson. *Prereq.*: Chem. 62 and Chem. 48. 1 lec.; 1 cr.

111. ORGANIC CHEMISTRY. The chemistry of the polynuclear compounds and heterocyclic systems. Mr. Iddles. 3 lec.; 3 cr.

112. ORGANIC CHEMISTRY. The chemistry of natural products. Mr. Iddles. 3 lec.; 3 cr.

115. ORGANIC QUALITATIVE ANALYSIS. The reactions and properties of organic compounds. Use of group reactions in the identification of organic substances. Mr. Atkinson. 1 lec.; 2 to 4 lab.; 3 to 5 cr.

116. ORGANIC MICRO-QUANTITATIVE ANALYSIS. Estimation of carbon and hydrogen by combustion, Dumas nitrogen, Kjeldahl nitrogen, estimation of halogens, of sulphur, and of organic radicals. Mr. Atkinson. 1 lec.; 2 lab.; 3 cr.

117. STEREOCHEMISTRY. A brief review of the structural theory of organic chemistry is followed by a discussion of stereoisomerism including methods of determining configuration, resolution, and applications in the study of reaction mechanisms. Mr. Kuivila. *Prereq.*: Chem. 56 or equivalent. 3 lec.; 3 cr.

118. REACTION MECHANISMS. Molecular rearrangements, tautomerism, and a few other important reactions are discussed with emphasis on the mechanisms involved. Mr. Kuivila. *Prereq.*: Chem. 117 is recommended but not required. 3 lec.; 3 cr.

121. PHYSICAL CHEMISTRY — CHEMICAL THERMODYNAMICS. Review of the first law of thermodynamics. Extension of it to systems more commonly studied in physics. The second and third laws. Applications of all three laws to homogeneous and heterogeneous systems, especially to non-ideal solutions, galvanic cells, and solutions of electrolytes. Statistical thermodynamics. Mr. O'Loane. *Prereq.*: One year of physical chemistry. 3 lec.; 3 cr.

122. PHYSICAL CHEMISTRY — CHEMICAL KINETICS. A study of the kinetics of homogeneous and heterogeneous reactions in gaseous and liquid systems, including an introduction to photochemistry. Mr. Daggett. *Prereq.*: One year of physical chemistry. 3 lec.; 3 cr.

124. ADVANCED PHYSICAL CHEMISTRY LABORATORY. The more modern experimental technique of physical chemistry. Emphasis on the needs and interests of each individual student. Topics will include the measurement of refractive index, molecular rotation, activity coefficients by vapor pressure and E.M.F. methods, heterogeneous and homogeneous equilibrium constants, and kinetic constants. Mr. O'Loane. 1 lec.; 2 lab.; 3 cr.

131-132. COLLOQUIUM IN CHEMISTRY.

- a. Advanced Inorganic Chemistry, Mr. Haendler.
- b. History of Chemistry, Mr. Funkhouser.
- c. Organic Chemistry, Mr. Atkinson
- d. Theoretical Organic Chemistry, Mr. Kuivila.
- e. Organic Chemistry, Mr. Iddles.
- f. Physical Chemistry, Mr. O'Loane.
- g. Physical Chemistry, Mr. Millard.
- h. Physical Chemistry, Mr. Wheeler
- i. Analytical Chemistry, Mr. Daggett.

3 lec.; 3 cr. Sections of the course may be taken to a total of 12 cr.

141-142. SEMINAR. Presentation and discussion of recent investigations in the field of chemistry. No credit.

151, 152. PROBLEMS IN CHEMISTRY. Conferences, library, and experimental work in some field of chemistry. Analytical Chemistry and Photochemistry, Mr. Daggett; Inorganic Chemistry, Mr. Haendler; Organic Chemistry, Mr. Iddles, Mr. Funkhouser, Mr. Atkinson, and Mr. Kuivila; Physical Chemistry, Mr. O'Loane. Mr. Millard, Mr. Wheeler. *Prereq.*: Special permission. Credits to be arranged.

## CIVIL ENGINEERING

EDMOND W. BOWLER, *Chairman*

In addition to the general requirements for all Graduate Students, a candidate for the degree of Master of Science in Civil Engineering must present evidence of undergraduate training equivalent to that given to candidates for the Bachelor of Science Degree in this department. A thesis of professional character and no fewer than 21 semester credits of course work constitute the requirements for the Master's Degree.



No thesis credit shall be given until the completed thesis has been approved by the committee on the thesis. No letter grade shall be given for the thesis but its satisfactory acceptance will be recorded with a Cr. (credit).

**THESIS REGULATIONS.** All theses must be typewritten upon standard paper, 8½ x 11 inches, medium weight. The title page shall bear the following statement:

*A thesis submitted to the University of New Hampshire in partial fulfillment of the requirements for the Degree of*  
*Master of Arts*  
*Master of Education*  
*Master of Science*

The second page of each copy of the thesis shall bear the date and signature of each member of the examining committee following the statement:

*This thesis has been examined and approved.*

(Signed) .....  
Name Date

Whenever a thesis is printed, it must be designated as having been accepted as a master's thesis by the University of New Hampshire.

Two copies of the approved thesis, ready for binding, shall be turned in to the Graduate School Office not less than two weeks before commencement, together with a receipt for the binding fee from the Treasurer's Office. Most departments require one copy of the thesis in addition to the above mentioned two copies. (See departmental requirements).

**SPECIAL REQUIREMENTS.** The student must meet the special requirements of the department in which he is doing his graduate work and his program must be approved by his adviser and the Dean of the Graduate School. For these special requirements see the departmental statements.

## LIVING FACILITIES

**HOUSING.** While the University cannot guarantee room reservations in dormitories which are primarily for undergraduate students, every attempt will be made to secure housing for Graduate Students. For information concerning housing, unmarried students should write to the Secretary of Room Assignments, Thompson Hall. Married students should write to the Manager, College Road Apartments, for information on campus and off-campus housing.

BOARD. The University operates on a self-service basis a modern, well-appointed dining hall. Regular weekly board and cafeteria service are provided at approximately \$10.

## COUNSELING SERVICE

THE COUNSELING SERVICE assists students in discovering vocational abilities and aptitudes, in self evaluation, and in the development of sound plans and objectives. It furnishes students with occupational and educational information as to requirements and opportunities. Personal counsel and guidance is offered to those students facing problems of emotional and social adjustment. It is the University's official testing agency charged with the administration of large-scale testing programs such as the Graduate Record Examination, the Orientation Week Program, and others of a similar nature. In co-operation with the Admissions Office, the Counseling Service participates in the School Testing Service and is available to all requesting technical information concerning problems of guidance and testing.

## HEALTH SERVICE

THE UNIVERSITY HEALTH SERVICE, located in Hood House, is devoted to the protection, improvement, and maintenance of student health. A well-equipped out-patient clinic for diagnosis and treatment of ambulatory patients and a modern hospital of 26 beds, with private and semi-private rooms, wards, and an isolation division for communicable diseases, are constantly available for students who require medical or surgical care. Registered nurses are on duty at all times. Individual health guidance is given through personal conferences with the University physicians.

Injury and illness which require hospital confinement other than in Hood House, services of specialists, operations, ambulance service, special nurse, or special prescriptions are at the expense of the student. Bed patients at Hood House are charged \$2.00 per day. Office Hours of the University Physician are from 8:00 A.M. to 4:30 P.M. daily except Saturday afternoons and Sundays.

## MEDICAL INSURANCE

STUDENTS' MEDICAL REIMBURSEMENT INSURANCE. In addition to the health service available through Hood House, group accident and sickness insurance giving 12 months' coverage is available to students at the University. This insurance coverage is designed to supplement the program of the University. Complete details may be had on application to John C. Paige and Company, 40 Broad Street, Boston, Mass.

## DURHAM NOTCH HALL

DURHAM NOTCH HALL serves as a temporary home for the Student Union, pending erection of the permanent memorial union building. It serves as a gathering place for students. Card games and ping-pong are available. The Student Union Board, on which there is student, faculty and alumni representation, carries on an extensive cultural, social, and service program.

## PLACEMENT BUREAU

THE PLACEMENT BUREAU assists Seniors, Graduate Students, and Alumni to secure positions after graduation. It corresponds with and interviews school superintendents, personnel managers of industrial concerns, and others who employ baccalaureate and advanced degree students, calling to their attention Seniors, Graduate Students, and Alumni who are seeking positions. The Placement Bureau and the Counseling Service are closely allied.

## THE ALUMNI ASSOCIATION

Upon leaving the institution, all students of the University (both undergraduate and graduate) automatically become members of the University of New Hampshire Alumni Association. The present membership of the Association exceeds 15,000 men and women who represent New Hampshire College and University of New Hampshire classes from 1881 to 1950. Alumni reside in every state of the Union as well as in many foreign countries.

Governed by a Board of Directors of 12 elected members, the Alumni are organized by classes and clubs. Class reunions are held annually in June, both in Durham and in adjacent communities. An annual Homecoming Day in the fall provides opportunity for Alumni to return to Durham while the University is in session. A football game with a traditional rival and a reunion with former classmates and friends are the outstanding features of Homecoming Day. Other Alumni gatherings on campus are also scheduled from time to time during the academic year. Every year 35 UNH Alumni Clubs throughout the United States hold from one to six meetings each. The Clubs' annual meetings are held simultaneously as a Founder's Day occasion on "Ben Thompson's Birthday", April 22. A monthly magazine, *The New Hampshire Alumnus*, issued ten times a year, circulates news of students, faculty, Alumni, and the University to Association subscribers. From Alumni Offices in Thompson Hall the Association's activities are directed by a permanent Alumni Secretary.

# Departmental Requirements and Descriptions of Courses

If the numerals designating a course running through both semesters are connected by a hyphen, the first semester's work, or its equivalent, is a prerequisite to the second. If the numerals are separated by a comma, properly qualified students may take the second semester's work without having had the first.

The Graduate School reserves the right not to offer an announced course when valid reasons arise.

## AGRICULTURAL AND BIOLOGICAL CHEMISTRY

THOMAS G. PHILLIPS, *Chairman*

Students majoring in this department are expected to have had preparation in the biological sciences, in mathematics, in physics, and in General Analytical, and Organic Chemistry.

51-52. **PHYSIOLOGICAL CHEMISTRY.** The chemistry of fats, carbohydrates, and proteins; colloids, enzyme action, digestion, metabolism, and excretion. The qualitative and quantitative examination of blood and urine. Mr. Shimer, Mr. Teeri. *Prereq.:* Satisfactory preparation in Organic Chemistry and Quantitative Analysis. 3 lec.; 2 labs.; 5 cr.

53, 54. **AGRICULTURAL ANALYSIS.** A study of the methods of analysis of soils, fertilizers, feeding stuffs, and other products important in agriculture. Mr. Phillips, Mr. Shimer, *Prereq.:* Satisfactory preparation in Organic Chemistry and Quantitative Analysis. 1 lec.; 3 lab.; 4 cr.

56. **PHYSIOLOGICAL CHEMISTRY.** An introductory but comprehensive study of the theory, problems, and techniques involved in the qualitative and quantitative methods commonly used in medical diagnostic work. Mr. Teeri. *Prereq.:* Satisfactory preparation in Organic Chemistry and Quantitative Analysis. 3 lec.; 2 lab.; 5 cr.

101, 102. **ADVANCED BIOCHEMISTRY.** The preparation, composition, and analysis of carbohydrates, fats, and proteins. Discussions and laboratory. Mr. Phillips, Mr. Shimer. *Prereq.:* Satisfactory preparation in Analytical, Organic, and Biological Chemistry. 4 cr.

103, 104. SPECIAL PROBLEMS. Conferences, and library and laboratory work on special phases of chemistry in its relation to agriculture and biology. Mr. Phillips, Mr. Shimer, Miss Purinton, Mr. Teeri. *Prereq.*: Satisfactory preparation in Analytical, Organic, and Biological Chemistry. Subject matter and credits to be arranged.

## AGRICULTURAL ECONOMICS

HARRY C. WOODWORTH, *Chairman*

Admission as a major in Agricultural Economics may be granted those who have satisfied the requirements for admission to the Graduate School and present evidence of satisfactory training in the fields of agriculture and economics. Normally, this will mean a degree from a college of agriculture and 9 or more credits in economics, including Agricultural Economics, as evidence of aptitude for advanced training in the field of Agricultural Economics. The requirement of a degree from a college of agriculture may be waived in the case of a mature student who has a degree in a field other than agriculture, (providing he presents evidence of an intimate knowledge of farm production and marketing practices), upon approval of the Chairman of the Department.

52. CO-OPERATIVE BUSINESS. Stress is placed on the organizational, legal, and financial problems of farmers' business corporations engaged in buying and selling. Selected problems of general agricultural marketing are integrated with the course content. Mr. Grinnell. 3 lec.; 3 cr.

56. AGRICULTURAL MARKETING. The market structure responsible for the distribution of agricultural products will be reviewed. Emphasis will be placed on the theory of price determination, interregional trade, imperfect competition, and public and private administration of prices in agriculture. Mr. Bowring. 3 lec.; 3 cr.

60. AGRICULTURAL POLICY. Public policies concerning land utilization, conservation of soil and forest resources, price supports, and production control will be studied and appraised. The objectives and effect of various action programs will be noted. Mr. Woodworth. 3 lec.; 3 cr.

67-68. SPECIAL PROBLEMS IN AGRICULTURAL ECONOMICS. Special assignments in readings and problems to satisfy students' needs. Mr. Woodworth, Mr. Grinnell, Mr. Burkett, Mr. Bowring. 1 to 3 cr.

101-102. **ADVANCED FARM MANAGEMENT.** Principles and problems of Farm Management as applied to the organization and operation of individual farms. Mr. Burkett. 3 cr.

106. **ADVANCED LAND UTILIZATION AND AGRICULTURAL POLICY.** An appraisal of national and local policies and proposed action programs affecting American agriculture. Assigned readings and conferences. Mr. Woodworth. 3 cr.

107. **ADVANCED STATISTICS FOR AGRICULTURE.** Use of statistical tools in measurement and analysis of data. Assigned problems and conferences. Mr. Bowring. 3 cr.

181-182. **READING AND RESEARCH IN AGRICULTURAL ECONOMICS.** With the advice and consent of the instructor, a student, prepared by training and experience to do independent work, may register for a reading and research course. The student will undertake assigned problems and readings under guidance of the instructor.

## AGRONOMY

FORD S. PRINCE, *Chairman*

Students majoring in Agronomy should have had basic courses in soils and crops as well as adequate preparation in the biological and physical sciences.

57. **SOIL PHYSICS.** The physical constitution and colloidal properties of soils: their measurement and relation to structure, water movement, aeration and temperature in soil. Mr. Kardos. *Prereq.:* Agron. 11, 14, and Phys. 2. 2 lec.; 1 lab.; 3 cr. (Alternate years; offered in 1950-51.)

58. **SOIL CLASSIFICATION AND MAPPING.** The origin, morphology, classification, and mapping of soils. Relationships of the Great Soil Groups of the world to crop production. Special emphasis is devoted to the soils of New Hampshire. Mr. Feuer. *Prereq.:* Agron. 1, and other courses at the discretion of the instructor. 2 lec.; 1 lab.; 3 cr. (Alternate years; offered in 1950-51.)

59. **SOIL CHEMISTRY.** A study of the methods for evaluating nutrient levels in soils and of principles underlying the liberation, absorption, and fixation of nutrient elements in soils. Mr. Kardos. *Prereq.:* Agr. Chem. 1, 2, and Agron. 11, 14. 2 lec.; 1 lab.; 3 cr. (Alternate years; offered in 1950-51.)

60. **SOIL CONSERVATION.** The causes and effects of soil erosion. Cropping systems, fertilizer practices, and structural devices

used in erosion control. Mr. Feuer. *Prereq.*: Agron. 11, 14, 21. 1 lec.; 2 lab.; 3 cr. (Alternate years; offered in 1950-51.)

71, 72. AGRONOMY SEMINAR. Library and reference work on special phases of soil and crop problems. Practice in looking up literature and in preparation of reports and abstracts. Mr. Prince and staff. *Prereq.*: Agron. 11, 14, 21. 1 to 3 cr.

101-102. AGRONOMY. Studies in comparative agronomy. The forage crops of the temperate zone. Origin and classification of the varieties grown. Germination, growth, and maturation of crops; modifications induced by climate and management. Mr. Prince. *Prereq.*: A major in Agronomy or its equivalent. Conferences, laboratory, and field work. Hours to be arranged. 3 cr.

103. ADVANCED SOIL FERTILITY. Lectures, discussions, problem work in the laboratory and greenhouse. Discussion of theories concerning nutrient availability and fixation. Use of biological methods for major and minor nutrient assays. Principles of experimental design in field plots. Mr. Kardos. *Prereq.*: Agron. 59 and Agr. Chem. 54 or Chem. 22. 3 cr.

104. ADVANCED SOIL CHEMISTRY. Lectures, discussions, and problem work in laboratory. Physical chemistry of soils and soil colloidal phenomena. Anion and cation exchange mechanisms in soils. Theories of swelling. Crystallographic properties of the clay colloids and their relation to cation and anion exchange. The nature of soil acidity. Oxidation-reduction phenomena in soils. Mr. Kardos. *Prereq.*: Agron. 59 and Agr. Chem. 54 or Chem. 22. (Chem. 82 or 84 recommended.) 3 cr.

## ANIMAL INDUSTRY

KENNETH S. MORROW, *Chairman of Dairy Husbandry*

LORING V. TIRRELL, *Chairman of Animal Husbandry*

Students majoring in Animal Industry are expected to have had satisfactory undergraduate training in Dairy Husbandry, Dairy Industry, or Technology, or Animal Husbandry.

51. ANIMAL BREEDING. The principles and practices of breeding farm animals, including cross-breeding, in-breeding, selection, inheritance, breed analysis, reproductive efficiency, fertility, sterility, Mendelism in relation to farm animals, acquired characteristics and variation. Practice is given in tracing and studying pedigrees. Mr. Tirrell. 2 lec.; 1 lab.; 3 cr.

52. ANIMAL HUSBANDRY SEMINAR. Library and reference work and the preparation of papers on various animal husbandry subjects. Mr. Tirrell. *Prereq.*: A.H. 51. Hours and credits to be arranged.

60. DAIRY SEMINAR. Recent agricultural experiment station and other literature covering the field of dairy production. Practice in looking up literature and in the preparation of oral and written reports. Mr. Morrow, Mr. Keener. 2 lec.; 2 cr.

62. ADVANCED DAIRY SCIENCE. Basic data, fundamental observations, and discussions of research contributing to the present status of the dairy industry. Mr. Moore. *Prereq.*: Adequate preparation in chemistry and bacteriology. 2 lec.; 2 cr.

64. MILK PRODUCTION. Feeding and management of dairy animals, calf feeding, raising young stock, and feeding for economical milk production. Mr. Keener. 2 lec.; 1 lab.; 3 cr.

65. MARKET MILK. The producing, handling, and distributing of market and certified milk, dairy farm inspection, and control of milk supply. Mr. Moore. 2 lec.; 1 lab.; 3 cr.

66. ICE CREAM. The making, handling, and marketing of ice cream and ices. Mr. Moore. 2 lec.; 1 lab.; 3 cr.

101. ANIMAL NUTRITION. Incidental lectures, assigned reading, and laboratory practice in methods of research with major emphasis on protein and energy metabolism. Mr. Colovos. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry, or equivalent. 3 cr.

102. ADVANCED DAIRY CATTLE. Special emphasis will be given to the analysis and formulating of breeding programs and to milk secretion and factors influencing the quantity and quality of milk. Mr. Morrow. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry. 2 lec.; 1 lab.; 3 cr.

105. PROBLEMS IN ANIMAL BREEDING. Studies in practical breeding problems with beef and dual-purpose cattle, sheep, horses, and hogs. The genetic principles important to successful livestock production will be emphasized. Mr. Tirrell. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry. 2 lec.; 1 lab.; 3 cr.

106. MEATS, LIVESTOCK MARKETS, AND PRODUCTS. The essential factors in meat selection, cutting, curing, and smoking; study and discussion relative to the problems of livestock marketing and the procedure in the large central markets. Trips are taken to various packing plants. Mr. Tirrell. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry. 2 lec.; 1 lab.; 3 cr.



107. TECHNICAL CONTROL. Chemical and bacteriological laboratory methods used in the technical control of milk and milk products. Mr. Moore. *Prereq.*: D.H. 30 or equivalent. 2 lec.; 1 lab.; 3 cr.

109, 110. SPECIAL PROBLEMS IN DAIRY MANUFACTURE. Detailed study of some special phase of dairy manufacturing. Mr. Moore. *Prereq.*: A major in Dairy Husbandry. Conferences and special assignments. 3 cr.

111, 112. SPECIAL PROBLEMS IN DAIRY PRODUCTION. Study of some special phase of breeding or feeding as related to dairy-herd management. Mr. Morrow, Mr. Keener. *Prereq.*: A major in Animal Husbandry or Dairy Husbandry. Conferences and special assignments. 3 cr.

## BACTERIOLOGY

LAWRENCE W. SLANETZ, *Chairman*

Students majoring in Bacteriology are expected to have had preparation in the biological and physical sciences and in the basic courses in Bacteriology. A thesis is required and a candidate for the Master's Degree shall pass an oral examination covering his graduate courses and thesis.

53. IMMUNOLOGY AND SEROLOGY. The theories of infection and immunity; production of vaccines; toxins, and antisera; serological techniques for disease diagnosis and identification of bacteria, including agglutination, precipitin, and complement fixation tests. Mrs. Bartley. *Prereq.*: Bact. 8. 2 lec.; 2 lab.; 4 cr.

55, 56. PROBLEMS IN BACTERIOLOGY. Special problems, depending upon the training and desire of the student. Elective only upon consultation. Mr. Slanetz and members of the staff. Credits to be arranged.

57, 58. BACTERIOLOGY SEMINAR. Reports and discussions on current literature and recent developments in Bacteriology. Mr. Slanetz and staff. *Prereq.*: Bact. 2 or 8 and consent of instructor. 1 rec.; 1 cr.

101. PHYSIOLOGY OF BACTERIA. A study of the growth, nutrition, and metabolism of bacteria; influence of physical and chemical environment on growth; bacterial enzymes, protein decomposition and fermentation. Mr. Howe. *Prereq.*: Organic Chemistry and Bact. 2 or 8, or equivalent. 3 lec.; 3 cr.

104. **SYSTEMATIC BACTERIOLOGY.** A study of procedures and methods for the classification of bacteria; review of modern systems of classification. Mr. Slanetz. *Prereq.:* Bact. 2 or 8 or equivalent. 2 lec.; 1 lab.; 3 cr.

108. **PATHOGENIC AND DIAGNOSTIC BACTERIOLOGY.** A study of the morphological, cultural, biochemical, serological, and pathogenic characteristics of microorganisms causing human and animal diseases. Students will be expected to perform the laboratory procedures for the diagnosis of various infectious diseases. Mr. Slanetz, Mrs. Bartley, Mr. Howe. *Prereq.:* Bact. 1 or equivalent. 2 lec.; 2 lab.; 4 cr.

109, 110. **BACTERIOLOGY SEMINAR.** Reports and discussions on bacteriological literature and recent developments in bacteriology. Mr. Slanetz and staff. *Prereq.:* Permission of the instructor. 1 rec.; 1 cr.

153. **ADVANCED IMMUNOLOGY AND SEROLOGY.** The theories of infection and immunity; production of vaccines; toxins, and antisera; serological techniques for disease diagnosis and identification of bacteria, including agglutination, precipitin, and complement fixation tests. Students will be assigned special problems on certain phases of the lecture or laboratory work. Mrs. Bartley. *Prereq.:* Bact. 8. 2 lec.; 2 lab.; 4 cr.

## BIOLOGY

GEORGE M. MOORE, *Chairman of Committee*

Students who wish to secure the Master's Degree in Biology must have completed an undergraduate major in Biology or in some field of the biological sciences. Suitable training in the physical sciences is also necessary. Students lacking undergraduate training in any of the fields of the biological sciences may be required to complete certain courses in these fields which do not carry graduate credit before they are admitted to candidacy for a degree.

Graduate work in Biology is under the direction of a committee consisting of the Chairmen of the Departments of Bacteriology, Botany, Entomology, and Zoology. This committee shall determine, in light of the student's objectives, the courses and requirements to be met by the candidate. Candidates for the Master's Degree in Biology shall pass an oral examination covering their general preparation in the field, and the thesis.

**THESIS REQUIREMENTS.** A thesis will generally be required of a student securing the Master's Degree in Biology. The number of

thesis credits will be *six*. In certain cases, where it seems appropriate in the light of the student's educational objectives, the thesis requirement may be waived. Permission to waive the thesis requirement will be granted on recommendation of the committee mentioned above. When permission is granted to waive the thesis requirement, the student shall present two graduate credits in Seminar (Bact. 57, 58; or Zool. 87, 88).

91. BIOLOGY-EDUCATION. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY. Objectives and methods of teaching; the selection and organization of materials; the preparation of visual aids; the setting up of aquaria and other projects. Some instruction in the preparation of biological materials for the classroom; instruction in making models and aquaria. The use of the field trip as a tool in teaching high-school biology. *Prereq.*: Two years of biological sciences and Ed. 61. 2 rec.; 1 lab.; or field trip; 3 cr.

95. BIOLOGY-EDUCATION. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY. Objectives and methods of teaching; the selection and organization of materials; the preparation of visual aids; the setting up of aquaria and other projects. Some instruction in the preparation of biological materials for the classroom; instruction in making models and aquaria. The use of the field trip as a tool in teaching high-school biology. This course is acceptable for Biology-Education 91; however, students who already have credit for Biology-Education 91 will not receive credit for this course. Mr. Davis. *Prereq.*: Either 1) Two years of biological science and Ed. 61, or 2) A year of teaching of high-school biology. 2 rec.; 2 lab.; or field trip; 4 cr. (*Offered in summer only.*)

For listings of other courses see: Bacteriology, Botany, Entomology, and Zoology.

## BOTANY

ALBION R. HODGDON, *Chairman*

Students who desire a Master's Degree in Botany are expected to have had adequate preparation in basic botany courses and in the physical sciences. The candidate will be required to pass an oral examination and to prepare a thesis. Thesis credits may be from 6-10 depending on the research problem involved. The subject-matter fields for graduate study in Botany are: Systematic Botany and Plant Ecology, Mr. Hodgdon; Plant Physiology, Mr. Dunn; Plant Morphology and Anatomy and Cytology, Miss Nast; Plant Pathology and Mycology, Mr. Richards.

51. PLANT PATHOLOGY. The nature of disease in plants, the etiology, symptomatology, and classification of plant diseases. Mr. Richards. *Prereq.*: Bot. 1 or Bot. 3. 1 lec.; 2 lab.; 3 cr.

52. PRINCIPLES OF PLANT-DISEASE CONTROL. Exclusion, eradication, protection, and immunization, and the specific, practical methods used to control plant diseases. Mr. Richards. *Prereq.*: Bot. 1 or Bot. 3 1 lec.; 2 lab.; 3 cr. (Not given in 1950-51.)

55. ADVANCED SYSTEMATIC BOTANY. The principles and laws of plant classification and nomenclature; study of plant families, field, and herbarium work. Mr. Hodgdon. *Prereq.*: Bot. 6. Hours to be arranged. 4 cr.

57, 58. PROBLEMS IN (a) SYSTEMATIC BOTANY, (b) PLANT PHYSIOLOGY, (c) PLANT PATHOLOGY, and (d) PLANT ANATOMY AND CYTOLOGY. Elective only upon consultation with Chairman of Department. Mr. Hodgdon, Mr. Dunn, Mr. Richards, Miss Nast. Hours to be arranged. 2 to 6 cr.

102. ADVANCED PLANT ECOLOGY. Requirements for growth; specialization and adaptation; geographic and physiographic relations. Regional floras. Interpretation and classification of habitat. Special problems are assigned. Mr. Hodgdon. Incidental lectures, laboratory, and field work. 4 cr.

104. HISTOLOGICAL TECHNIQUES. A methods course in embedding, sectioning, and staining plant tissues, and preparation of toto mounts. Miss Nast. *Prereq.*: Bot. 1 or Bot. 3. 3 cr.

105. ADVANCED PLANT PHYSIOLOGY. Absorption, translocation, transpiration, and excretion of water, and effect of environmental factors upon these phenomena; permeability and mineral nutrition. Mr. Dunn. *Prereq.*: Bot. 40 or equivalent, or adequate preparation in the physical sciences. Conferences, laboratory, and assigned reading. 3 cr. (*Note*: Both Bot. 105 and 106 should be taken for a complete covering of the subject.)

106. ADVANCED PLANT PHYSIOLOGY. Photosynthesis; respiration, growth, reproduction, and movement; effect of environmental factors on these phenomena. Mr. Dunn. *Prereq.*: Bot. 40 or equivalent, or adequate preparation in the physical sciences. Conferences, laboratory, and assigned reading. 3 cr.

107, 108. PROBLEMS IN (a) SYSTEMATIC BOTANY, (b) PLANT PHYSIOLOGY, (c) PLANT PATHOLOGY, and (d) PLANT ANATOMY AND CYTOLOGY. Elective only upon consultation with Chairman of Department. Mr. Hodgdon, Mr. Dunn, Mr. Richards, Miss Nast. Hours to be arranged. 2 to 6 credits.

112. MYCOLOGY. Studies of the parasitic and saprophytic fungi, their growth, reproduction, and identification. Mr. Richards. Laboratory and assigned reading. 1 lec.; 2 lab.; 3 cr. (Not given in 1950-51).

# CHEMICAL ENGINEERING

OSWALD T. ZIMMERMAN, *Chairman*

To be admitted as a candidate for the degree of Master of Science in Chemical Engineering an applicant shall be expected to have completed a course of study substantially equivalent to that required for the degree of Bachelor of Science in Chemical Engineering in this University. However, students with good undergraduate records but with deficiencies in certain areas may be admitted on condition that they complete specified courses without credit to make up for their deficiencies.

71-72. UNIT PROCESSES. The important inorganic and organic industrial chemical processes from the point of view of the basic chemical reactions and physical operations involved. Mr. Zimmerman. *Prereq.*: Chem. 22. 2 lec.; 2 cr.

74-75. UNIT OPERATIONS. The theory and practice of the fundamental chemical engineering unit operations, including flow of fluids, flow of heat, evaporation, distillation, drying, filtration, gas absorption, extraction, humidification and air conditioning, crystallization, crushing and grinding, and size separation. Mr. Zimmerman. *Prereq.*: Ch. E. 71 and Chem. 83. 3 lec.; 3 cr.

76. CHEMICAL ENGINEERING ECONOMICS. The economic factors involved in industrial chemical processes and the application of economic balances to the design and selection of chemical engineering equipment. Mr. Zimmerman. *Prereq.*: Ch. E. 75, 77. 3 lec.; 3 cr.

77. UNIT OPERATIONS LABORATORY. Experiments based upon the unit operations are performed on typical chemical engineering equipment. Mr. Zimmerman. *Prereq.*: Chem. 74, 84. 3 lab.; 3 cr.

78. CHEMICAL PLANT DESIGN. The design and layout of chemical plants and equipment. The assigned problems are of a practical nature, such as the manufacture of some chemical product, and their solution will include the design or selection of all equipment and drawings of equipment, plant, and layout. Mr. Zimmerman. *Prereq.*: Ch. E. 75, 77. 3 lab.; 3 cr.

135. UNIT OPERATIONS — FLUID FLOW, HEAT FLOW, AND EVAPORATION. An advanced course dealing with the fundamental theory and applications of these operations. Mr. Zimmerman. *Prereq.*: Ch. E. 74 or equivalent. 2 lec. or rec.; 2 cr.

136. UNIT OPERATIONS — DIFFUSION OPERATIONS. An advanced study of the principles of diffusion and their application to

the unit operations of distillation, absorption, drying, humidification, and extraction. Mr. Zimmerman. *Prereq.*: Ch. E. 75 or equivalent. 2 lec. or rec.; 2 cr.

137, 138. UNIT PROCESSES. A study of the more recent developments in pyrolysis, oxidation, chlorination, nitration, and other unit processes. *Prereq.*: Ch. E. 72, Chem. 48, and Chem. 84, or equivalents. 2 lec.; 2 cr.

139. CHEMICAL ENGINEERING THERMODYNAMICS. A study of recent developments in thermodynamics with particular emphasis on low-temperature and high-pressure processes. *Prereq.*: Ch. E. 79 or equivalent. 2 lec.; 1 rec.; 3 cr.

141, 142. PROBLEMS IN CHEMICAL ENGINEERING. Independent investigations in some phase of chemical engineering. Mr. Zimmerman. *Prereq.*: Special permission. Credits to be arranged.

## CHEMISTRY

HAROLD A. IDDES, *Chairman*

Admission to graduate study in Chemistry requires the usual undergraduate courses in general chemistry, analytical chemistry, organic chemistry, and physical chemistry with the supporting courses in mathematics and physics

55, 56. STRUCTURAL AND THEORETICAL PROBLEMS OF MODERN ORGANIC CHEMISTRY. An intensive review of the methods of preparation and reactions of the principal classes of organic compounds. Emphasis is on the working of assigned problems. The electron theory of organic chemistry is used to correlate the chemical behavior of unsaturated compounds, free radicals, and other classes. Mr. Atkinson. *Prereq.*: Chem. 48 or 54. 3 lec.; 3 cr.

62. ADVANCED METHODS OF QUANTITATIVE ANALYSIS. The theory and technique of special and recently developed methods of analysis such as colorimetry, turbidimetry, potentiometry, and spectrography. Sufficient experience is obtained to allow the development of considerable skill in even the more complex methods. Mr. Millard. *Prereq.*: Chem. 22. 2 lec.; 2 lab.; 4 cr.

82. PRE-MEDICAL AND PRE-DENTAL PHYSICAL CHEMISTRY. Kinetic theory of gases; quantitative laws for behavior of matter in the gas, liquid, and solid phases; valence and the chemical bond; radioactivity; atomic structure and valence; laws of solution; homogeneous and heterogeneous equilibrium; colloids; electrochemistry. Mr. O'Loane. *Prereq.*: Chem. 2 or 4, Phys. 2, Math. 16. 3 lec.; 3 cr.

83-84. **ELEMENTARY PHYSICAL CHEMISTRY.** The properties of gases, liquids and solids; thermochemistry and thermodynamics; solutions, chemical equilibria, reaction rates, conductance and electromotive force. Mr. O'Loane. *Prereq.:* Chem. 22, Math. 18, Phys. 22. 3 lec.; 2 lab.; 5 cr.

85, 86. **ADVANCED PHYSICAL CHEMISTRY.** A review of selected topics in elementary physical chemistry followed by a study of the structure and properties of matter. *Prereq.:* Chem. 84 or equivalent. 3 lec.; 3 cr.

87, 88. **CHEMICAL LITERATURE AND SEMINAR.** Use of the chemical library; student reports on topics of interest. Mr. Atkinson. *Prereq.:* Chem. 62 and Chem. 48. 1 lec.; 1 cr.

111. **ORGANIC CHEMISTRY.** The chemistry of the polynuclear compounds and heterocyclic systems. Mr. Iddles. 3 lec.; 3 cr.

112. **ORGANIC CHEMISTRY.** The chemistry of natural products. Mr. Iddles. 3 lec.; 3 cr.

115. **ORGANIC QUALITATIVE ANALYSIS.** The reactions and properties of organic compounds. Use of group reactions in the identification of organic substances. Mr. Atkinson. 1 lec.; 2 to 4 lab.; 3 to 5 cr.

116. **ORGANIC MICRO-QUANTITATIVE ANALYSIS.** Estimation of carbon and hydrogen by combustion, Dumas nitrogen, Kjeldahl nitrogen, estimation of halogens, of sulphur, and of organic radicals. Mr. Atkinson. 1 lec.; 2 lab.; 3 cr.

117. **STEREOCHEMISTRY.** A brief review of the structural theory of organic chemistry is followed by a discussion of stereoisomerism including methods of determining configuration, resolution, and applications in the study of reaction mechanisms. Mr. Kuivila. *Prereq.:* Chem. 56 or equivalent. 3 lec.; 3 cr.

118. **REACTION MECHANISMS.** Molecular rearrangements, tautomerism, and a few other important reactions are discussed with emphasis on the mechanisms involved. Mr. Kuivila. *Prereq.:* Chem. 117 is recommended but not required. 3 lec.; 3 cr.

121. **PHYSICAL CHEMISTRY — CHEMICAL THERMODYNAMICS.** Review of the first law of thermodynamics. Extension of it to systems more commonly studied in physics. The second and third laws. Applications of all three laws to homogeneous and heterogeneous systems, especially to non-ideal solutions, galvanic cells, and solutions of electrolytes. Statistical thermodynamics. Mr. O'Loane. *Prereq.:* One year of physical chemistry. 3 lec.; 3 cr.

122. PHYSICAL CHEMISTRY — CHEMICAL KINETICS. A study of the kinetics of homogeneous and heterogeneous reactions in gaseous and liquid systems, including an introduction to photochemistry. Mr. Daggett. *Prereq.*: One year of physical chemistry. 3 lec.; 3 cr.

124. ADVANCED PHYSICAL CHEMISTRY LABORATORY. The more modern experimental technique of physical chemistry. Emphasis on the needs and interests of each individual student. Topics will include the measurement of refractive index, molecular rotation, activity coefficients by vapor pressure and E.M.F. methods, heterogeneous and homogeneous equilibrium constants, and kinetic constants. Mr. O'Loane. 1 lec.; 2 lab.; 3 cr.

131-132. COLLOQUIUM IN CHEMISTRY.

- a. Advanced Inorganic Chemistry, Mr. Haendler.
  - b. History of Chemistry, Mr. Funkhouser.
  - c. Organic Chemistry, Mr. Atkinson
  - d. Theoretical Organic Chemistry, Mr. Kuivila.
  - e. Organic Chemistry, Mr. Iddles.
  - f. Physical Chemistry, Mr. O'Loane.
  - g. Physical Chemistry, Mr. Millard.
  - h. Physical Chemistry, Mr. Wheeler
  - i. Analytical Chemistry, Mr. Daggett.
- 3 lec.; 3 cr. Sections of the course may be taken to a total of 12 cr.

141-142. SEMINAR. Presentation and discussion of recent investigations in the field of chemistry. No credit.

151, 152. PROBLEMS IN CHEMISTRY. Conferences, library, and experimental work in some field of chemistry. Analytical Chemistry and Photochemistry, Mr. Daggett; Inorganic Chemistry, Mr. Haendler; Organic Chemistry, Mr. Iddles, Mr. Funkhouser, Mr. Atkinson, and Mr. Kuivila; Physical Chemistry, Mr. O'Loane, Mr. Millard, Mr. Wheeler. *Prereq.*: Special permission. Credits to be arranged.

## CIVIL ENGINEERING

EDMOND W. BOWLER, *Chairman*

In addition to the general requirements for all Graduate Students, a candidate for the degree of Master of Science in Civil Engineering must present evidence of undergraduate training equivalent to that given to candidates for the Bachelor of Science Degree in this department. A thesis of professional character and no fewer than 21 semester credits of course work constitute the requirements for the Master's Degree.



52. FLUID MECHANICS. Properties of fluids; statics of fluids; theorems and criteria of fluid motion; fluid flow through orifices, tubes, nozzles and pipes; flow over weirs, flow in open channels; dynamics of fluids in motion. Laboratory exercises and stream gaging practice. Mr. Bowler. *Prereq.*: Math. 8. 3 rec.; 1 lab.; 4 cr.

61. HIGHWAY ENGINEERING. The economics of location and design of highways and city streets; methods of construction, maintenance, and specifications governing the various types of surfaces. The administration and methods of financing of highway systems. Selected problems of location and design are studied in the laboratory. Mr. Skelton. *Prereq.*: C.E. 6 and 15. 2 rec.; 2 lab.; 4 cr.

62. SOIL MECHANICS AND FOUNDATION. The principles underlying the behavior of various soils when subjected to structural loads. Problems and methods encountered in foundation design and construction, building codes and legal aspects of foundation construction, also test borings and other underground exploration methods. In the laboratory tests are made on various soils for classification, grain size, permeability, and consolidation. Reports and typical problems are included. Mr. Skelton. *Prereq.*: C.E. 65. 2 lec.; 1 lab.; 3 cr.

63-64. HYDRAULIC AND SANITARY ENGINEERING. Precipitation, water losses, run-off, drainage areas, stream flow, water power estimates, hydraulic turbines, dams and waterways; the sources, quantity, quality, and sanitary aspects of public water supplies; the methods of purification and distributing system; the theory and problems of sewage, the principles governing the disposal of sewage, and the various methods of sewage treatment. Computations, reports and problems of design are included. Mr. Bowler. *Prereq.*: C.E. 52. 3 rec.; 1 lab.; 4 cr.

65. STRUCTURAL DESIGN. Theory and problems relating to the analysis and design of steel and timber structures. Typical design problems include the plate girder, mill bent, bridge trusses and selected parts of building frames. Economy of design and the interpretation of various specifications are emphasized. Mr. Skelton. *Prereq.*: C.E. 28. 2 rec.; 2 lab.; 4 cr.

66. REINFORCED CONCRETE STRUCTURES. Theory and design of reinforced concrete structures, such as beams, slabs, columns, footings, retaining walls, and small bridges. Mr. Skelton. *Prereq.*: C.E. 65. 2 rec.; 2 lab.; 4 cr.

103-104. SOIL MECHANICS. The physical and mechanical properties of soil in relation to engineering structures. The theory

of consolidation, shearing resistance, bearing capacity, settlement, and earth pressure. 3 lec.; 3 cr.

105. SOIL TESTING FOR ENGINEERING PURPOSES. Arranged to cover the essential soil tests for engineering purposes. Identification of soils, determination of water content, void ratio, specific gravity, grain size distribution, and Atterberg limits. Tests for the physical properties include: permeability, capillarity, compressibility, rate and magnitude of consolidation, and shearing resistance. Mr. Skelton. *Prereq.*: C.E. 103 in parallel or as a prerequisite. 1 lec.; 3 lab.; 4 cr.

106. FOUNDATION ENGINEERING. Application of the principles of soil mechanics to selection of type of substructure, foundation construction methods, exploratory soil studies, stability analysis, earth dam and tunnel construction, and underpinning operations. Mr. Skelton. *Prereq.*: C.E. 62. 3 lec.; 3 cr.

107-108. HIGHWAY PLANNING AND ADMINISTRATION. A comprehensive study of highway planning for both rural and urban areas, planning and traffic surveys, methods, and the interpretation of data for the purpose of programming highway modernization. Economic analysis of highway improvement and urban traffic studies. Highway finance and administration. Mr. Skelton. *Prereq.*: C.E. 61. 3 lec.; 3 cr.

109. ADVANCED HIGHWAY DESIGN. Advanced theory and practice in design of highway alignment, cross sections, inter-sections, interchanges, multilane express and arterial highways, free-ways, and limited access highways. Mr. Skelton. *Prereq.*: C.E. 61. 3 lec.; 1 lab.; 4 cr.

111-112. ADVANCED HYDRAULICS. Dimensional analysis, dynamic similarity, mechanics of viscous fluids, fluid flow in pipes, non-uniform flow, alternate stages of flow in open channels, hydraulic jump, and their application to engineering practice. Mr. Bowler. *Prereq.*: C.E. 64. 3 rec.; 3 cr.

113. EXPERIMENTAL HYDRAULICS. Experimental application of the material covered in C.E. 111 and 112. Mr. Dawson. *Prereq.*: C.E. 111 taken concurrently. 3 lab.; 3 cr.

115-116. ADVANCED HYDRAULIC ENGINEERING. Hydrology, hydraulics of river flow, flood flows, design of reservoirs, flood control, river control, and hydraulic structures. Mr. Dawson. *Prereq.*: C.E. 64. 3 rec.; 3 cr.

# ECONOMICS

JOHN A. HOGAN, *Chairman*

Graduate work is offered in Economics leading to the Degree of Master of Arts.

Admission to candidacy for a Master's Degree in Economics is limited to students with a satisfactory undergraduate record. The prerequisite for graduate work consists of a minimum of 24 hours of undergraduate work in Economics and related fields of which at least 12 hours shall have been in Economics. The Economics requirement includes a year's work in Principles of Economics.

The candidate for a Master's Degree must fulfill the general requirements of the Graduate School and the following departmental requirements: 18 hours graduate credit in the Department of Economics in courses numbered above 100; a thesis which may fulfill a maximum of 6 credits toward the course requirement numbered above 100; 12 hours graduate credits in the Department of Economics in courses numbered above 50. Courses in related departments to a maximum of 9 hours may be counted with the permission of the major adviser.

51. LABOR PROBLEMS. Historical background and present status of labor organizations and problems. Mr. Hogan. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

52. PUBLIC FINANCE. Theory and practice of public expenditures and collection of public revenues; problems and policies in financial administration, national, state, and local; taxation problems in the State of New Hampshire. *Prereq.*: Econ 2. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

53. MONEY AND BANKING. Theory and practice of money and banking. Mr. Degler. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

54. ADVANCED MONEY AND BANKING. Advanced monetary theory and some of the more practical aspects of modern banking. Mr. Degler. *Prereq.*: A satisfactory average in Econ. 53. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

55. CORPORATIONS. Development and forms of business organization and combination. Mr. Degler. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

56. CORPORATION FINANCE. Methods of financing corporate enterprise. Mr. Degler. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

58. PRINCIPLES OF INVESTMENT. The general principles of investment. The problem of investment; investment characteristics

of stocks and bonds; public utility, railroad, industrial, and government securities; protection of the investor; investment banking; and related problems. Mr. Degler. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

62. PUBLIC REGULATION OF BUSINESS. The Federal control of business organizations and their activities with special reference to recent legislation affecting business. Mr. Alexander. 3 lec. or rec.; 3 cr.

63. INTERNATIONAL TRADE. Theory of international trade, foreign exchange, balance of international payments, tariffs and protection; the economic aspects of international relations with particular reference to recent policies. Miss Woodruff. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

64. COMPARATIVE STUDY OF ECONOMIC SYSTEMS. An examination of socialism, communism, capitalism, and modifications of these types, particularly as exemplified by leading nations. *Prereq.*: Econ. 2 or permission of the instructor. Miss Woodruff. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

74. THE ECONOMICS OF CONTEMPORARY AMERICAN BUSINESS. The nature of business profits as molded by accounting; survey of the mechanisms yielding profits including producing and inventory accumulation, credit expansion, net capital formation, etc.; the effects of these upon inflation, the value of money, labor management problems, the desire for tariffs, business cycles, farm problems, high-pressure selling, and other economic problems of the times; some evaluation of Neo-Classical and Keynesian schools of economic thought. Mr. Shafer. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

76. VALUE AND DISTRIBUTION. An advanced course in economic theory. Emphasis is upon the theory of price and the distribution of income. Mr. Shafer. *Prereq.*: Econ. 2. 3 lec. or rec.; 3 cr.

151, 152. LABOR SEMINAR. Advanced study of labor markets, wage incentive systems, job evaluation, relation of wage policy to employment and problems raised by these and other factors in negotiating collective bargaining contracts. Collective bargaining studied as a means of establishing a system of industrial jurisprudence. Class discussion based primarily on case studies. Mr. Hogan. 3 lec. or rec.; 3 cr.

157-158. HISTORY OF ECONOMIC THOUGHT. A critical study of the development of economic concepts and ideas. Attention is given to the various schools of economic thought. *Prereq.*: 18 hours

of major credit in economics and the consent of the instructor. 3 lec. or rec.; 3 cr. (Not offered in 1950-51.)

177. INSTITUTIONALISM. The institutional approach in economic analysis; the theory of conflicts of interest, scarcity, and mutuality; theory of transactions; efficiency in relation to scarcity; futurity; habit and custom; sovereignty and legal foundations; reasonable value; some examination of the works of Locke, Hume, Veblen, Commons, Mitchell, Nourse, and others. Mr. Shafer. *Pre-req.*: 18 hours of major credits in Economics and the consent of the instructor. 3 cr.

181, 182. READING AND RESEARCH IN ECONOMICS. With the advice and consent of the instructor, a student prepared by training and experience to do independent work may register for a reading and research course. The student will undertake assigned problems and readings under the guidance of the instructor. Hours and credits by arrangement.

- A. Economic History, Miss Woodruff
- B. International Trade, Miss Woodruff
- C. Economic Theory, Mr. Shafer
- D. Labor Economics, Mr. Hogan
- E. Public Finance, Mr. Katz
- F. Money and Banking, Mr. Degler
- G. Corporations, Mr. Degler
- H. Accounting Theory, Mr. Johnson

## EDUCATION

THOMAS O. MARSHALL, *Chairman*

For admission to candidacy for a Master's Degree in Education, a student must present, in addition to a Bachelor's Degree, evidence of having satisfactorily completed either an undergraduate major in Elementary Education or (a) a year of Educational Psychology or its equivalent, (b) 18 semester credits in a teaching major subject, and (c) 12 semester credits in a first teaching minor subject.

For the Degree of Master of Education 30 credits must be earned. Each of the following courses, if not taken during undergraduate education, must be passed satisfactorily.

1. *Either*

Ed. 52. PRINCIPLES OF AMERICAN SECONDARY EDUCATION.

*or*

El. Ed. 95. WORKSHOP IN PRINCIPLES AND PRACTICES OF

## ELEMENTARY EDUCATION.

2. *Either*  
Ed. 61 or 160. PRINCIPLES AND PROBLEMS OF TEACH-  
ING IN SECONDARY SCHOOLS.  
*or*  
El. Ed. 98. WORKSHOP IN ELEMENTARY CURRICULUM  
PROBLEMS.
3. *Either*  
Ed. 91-92. PROBLEMS IN TEACHING THE MAJOR SUBJECT.  
*or*  
El. Ed. 90. WORKSHOP IN READING AND THE OTHER  
LANGUAGE ARTS.  
*or*  
El. Ed. 94. WORKSHOP IN UPPER-GRADE LANGUAGE ARTS  
AND TECHNIQUES OF PUPIL ORGANIZATION.
4. Ed. 65. EDUCATIONAL TESTS AND MEASUREMENTS. (Emphasis  
should be upon the interpretation of tests and meas-  
urements.)
5. Ed. 176. PHILOSOPHY OF EDUCATION.
6. Psych. 89. MENTAL HYGIENE FOR TEACHERS.

Students who meet the requirements given above are free to select, with the advice of the Chairman of the Department of Education, the remainder of their work required for the degree from Education and subject-matter courses arranged to secure most effective preparation for the professional work they desire to pursue. Students will be able to choose from a variety of courses designed to be helpful to students interested in increasing their teaching efficiency in the elementary school and the junior high school, as well as in the senior high school, to teachers and administrative officers interested in educational and vocational guidance, to teachers and administrative officers interested in physical education activities, and to educational administrators and teachers preparing to enter fields of administration or supervision.

52. (52). PRINCIPLES OF AMERICAN SECONDARY EDUCATION. The development and place of the secondary school in the American system of education; aims and functions of secondary education in our democracy; upward and downward extension of secondary education; articulation with lower and higher educational institutes, and with the community; the secondary-school pupil; adjustment of the work of the school to meet individual needs; the offerings, both curricular and extra-curricular, of the secondary school; place and relationships of school board, superintendent, headmaster, and teachers. Mr. Bretsch and Mr. Marshall. 2 or 3 cr.

61. (61). PRINCIPLES AND PROBLEMS OF TEACHING IN THE SECONDARY SCHOOL. (1) Secondary-school objectives and the objectives in the teaching of secondary-school subjects; (2) principles of teaching and of directing learning incorporated in teaching which meets the needs of high-school students and attains the objectives of the secondary school; (3) secondary-school tests and the ways in which teachers are endeavoring to ascertain the extent to which their objectives are being attained; (4) class management, the purpose of which is to insure conditions favorable to the attainment of the objectives of the secondary school. Mr. Koch. *Prereq.*: Permission of instructor; 2 or 4 cr.

63, (63). AUDIO-VISUAL AIDS IN THE ELEMENTARY AND SECONDARY SCHOOLS. A course intended to give teachers a practical working knowledge of the uses of the various types of audio-visual aids. The following aids will receive particular attention: the school journey; the school museum; silent and sound films and projectors; glass slides (commercial and handmade); strip films and projectors, with and without sound disc; transcriptions and radio broadcasts. This course will be centered around the problems which are common to the use of audio-visual aids in both elementary and secondary schools. Mr. Olney. 2 or 3 cr.

65. (65). EDUCATIONAL TESTS AND MEASUREMENTS. The nature of measurement. Classification and evaluation of tests. Standardized tests in subject-matter fields. Diagnosis and prognosis of pupils' aptitudes, achievement, attitudes, and interests in the public-school program with particular emphasis upon the role of tests. Mr. Marshall. *Prereq.*: Educational Psychology. 2 or 3 cr.

83, (83). PRINCIPLES OF EDUCATIONAL AND VOCATIONAL GUIDANCE. A study of the principles of guidance which are helpful in understanding and in solving the problems of guidance in the small high school. Mr. Menge. 2 or 3 cr.

87. PRINCIPLES AND PROBLEMS OF SECONDARY-SCHOOL CURRICULUM REORGANIZATION. The course will be concerned with significant changes in secondary-school offerings, with special emphasis upon curriculum revision and techniques of revision. Mr. Koch. 2 or 3 cr.

102, (102). PUBLIC SCHOOL ADMINISTRATION. This course is intended for Graduate Students who have had teaching or administrative experience, and are looking forward to further work as superintendent, principal, or department head. Emphasis will be placed upon the practical application of the following functions of public-school administration: policy making, management, per-



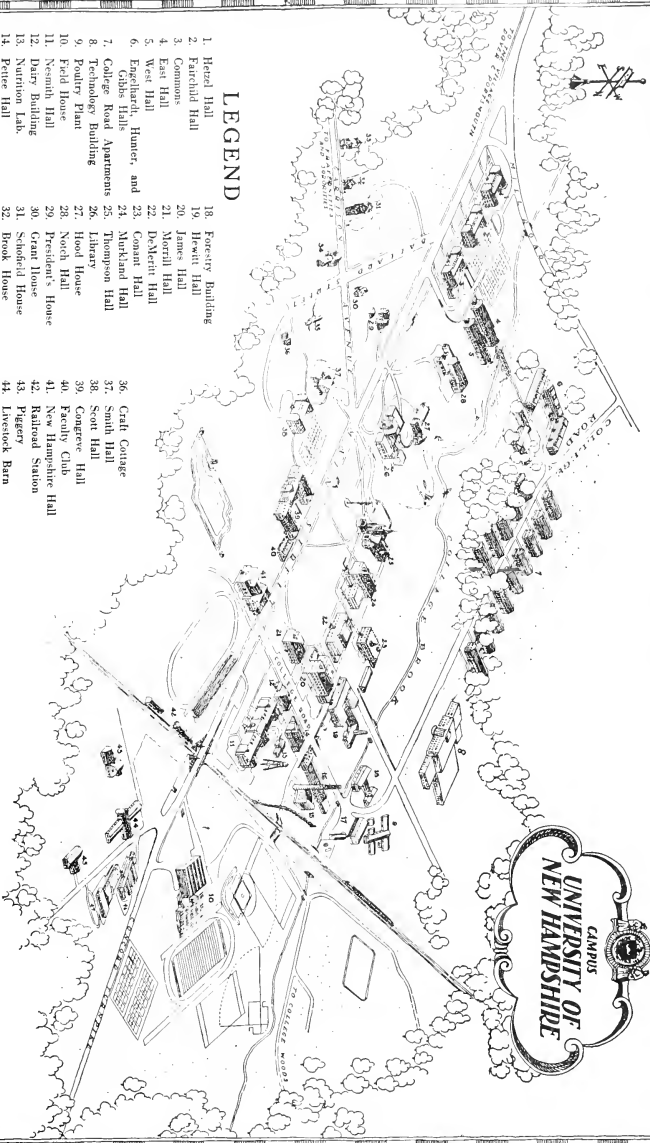


# UNIVERSITY OF NEW HAMPSHIRE

CAMPUS

## LEGEND

1. Hotel Hall
2. Fairchild Hall
3. Commons
4. East Hall
5. West Hall
6. Engelhardt, Hunter, and Gibbs Halls
7. College Road Apartments
8. Technology Building
9. Poultry Plant
10. Field House
11. Nesmith Hall
12. Dairy Building
13. Nutrition Lab.
14. Petrie Hall
15. Power Plant
16. Service Building
17. Service Garages
18. Forestry Building
19. Hewitt Hall
20. James Hall
21. Morrill Hall
22. DeMeritt Hall
23. Conant Hall
24. Murkland Hall
25. Thompson Hall
26. Library
27. Hood House
28. North Hall
29. President's House
30. Grant House
31. Schofield House
32. Brook House
33. Lucella Petrie House
34. Ballard Hall
35. Elizabeth DeMeritt House
36. Craft Cottage
37. South Hall
38. Scott Hall
39. Congreg. Hall
40. Faculty Club
41. New Hampshire Hall
42. Railroad Station
43. Pigery
44. Livestock Barn
45. Commission Barn
46. Greenhouses
47. Putnam Hall



sonnel, public relations, fiscal, housing, curricular, reportorial, research. Pursuit of practical term projects will be encouraged as well as having experience in attacking problems in school administration as buildings, budget, evaluating school housing, developing a schedule, etc. Mr. Bretsch. 2 or 3 cr.

111-112. WORKSHOP IN ADMINISTRATION IN THE JUNIOR AND SENIOR HIGH SCHOOLS. This course will be devoted to a study of basic principles of educational administration with their application to the following types of problems in the junior and senior high schools: the internal organization of the school, administering the program of studies, direction of extra-curricular activities, organization and direction of guidance, making the school schedule, selection of the staff, discipline and control, buildings and grounds, equipment and supplies, office organization, records and reports, administering finance, public relations and publicity. The course will be so organized as to permit students to specialize on problems of administration in the junior high school as well as in the senior high school. As the workshop technique of discussing practical problems will be utilized in the course, it is hoped that members of the group will bring problems for further discussion and study. Designed for individuals preparing for positions as principals and headmasters. 6 cr.

114. (114). WORKSHOP IN SECONDARY-SCHOOL CURRICULUM DEVELOPMENT. 2 or 3 cr.

118. (118). ORGANIZATION AND ADMINISTRATION OF GUIDANCE. 2 or 3 cr.

122. (122). PROBLEMS IN THE SUPERVISION OF HIGH-SCHOOL TEACHING. Consideration of the objectives of education, the objectives of supervision, and the role of supervisor in studying and evaluating the whole learning situation constitute the bases for the course. Emphasis will be placed upon the study of pupil and teacher diagnosis, pupil and teacher improvement, school material, and evaluation of supervising practices. Designed for headmasters, superintendents, and the supervisors of cadet teaching. Mr. Bretsch. 2 or 3 cr.

125. (125). EDUCATIONAL FINANCE AND BUSINESS MANAGEMENT. Aspects and principles of financing education, budgetary procedure, accounting, cost analysis, auditing school indebtedness, and financial reporting comprise the units to be studied. Experience in handling practical school finance problems will be part of the project work. Mr. Bretsch. *Prereq.*: Ed. 102 or equivalent in course or experience. 2 or 3 cr.

131-132. RESEARCH PROBLEMS IN SECONDARY EDUCATION. 2 to 6 cr.

150, (150). ADVANCED EDUCATIONAL PSYCHOLOGY. An intensive study of special topics in the field of educational psychology with emphasis upon the learning process. The study will concern itself with the following: (a) examination of learning situations in the classroom in the light of experimental research; (b) examination and evaluation of learning situations in the light of the major theories of learning. Mr. Koch. *Prereq.*: Educational Psychology. 2 or 3 cr.

160, (160). ADVANCED PRINCIPLES AND TECHNIQUES OF SECONDARY TEACHING. The course will concern itself with the formulation of teaching objectives and with the selection of objectives in terms of essential criteria. Course organization will be emphasized in terms of objectives and criteria, and the problem technique will be developed to square with such organization. Students will be expected to work in their major areas of interest. Mr. Koch. *Prereq.*: For Graduate Students with teaching experience. 2 or 3 cr.

161, (161). PRINCIPLES AND PROBLEMS OF HIGHER EDUCATION. A course dealing with the purposes, external influences, internal administration, curriculum, student personnel, and faculty problems of colleges and universities. Mr. Blewett. 2 or 3 cr.

163, (163). METHODS OF COLLEGE TEACHING. A course to help, through reading and discussion, present and potential college teachers make their instruction more effective. Included in the topics which may be studied are types of teaching such as lecturing, recitation, etc.; psychology of learning; student aptitudes; organization of material; term papers and reports; examinations and grading; advising students; evaluation of teaching; and the professional status of college teachers. Mr. Sackett. 2 or 3 cr.

176, (176). PHILOSOPHY OF EDUCATION. A study of current educational objectives and practices and the philosophical foundations upon which they are based. Mr. Marshall. *Prereq.*: Ed. 42, 51, 52. 3 rec.; 2 or 3 cr.

#### COURSES IN PROBLEMS IN TEACHING HIGH-SCHOOL SUBJECTS

\*The following courses are devoted to a study of problems of objectives, selection, and organization of subject matter, teaching and testing techniques and classroom management in the teaching

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\*For details concerning prerequisites and nature of these courses, see descriptions given under respective subject-matter departments.

of the respective subjects. To be admitted into one of these courses the student must have completed, with a grade of at least C, Education 61 and, in addition, the courses in the subject and related subjects designated as prerequisites to the respective courses in this group. A student desiring to be considered for supervised teaching must complete with a grade of at least C one of these courses in the subject in which he hopes to do supervised teaching. The satisfactory completion of two of these courses is required of students completing the University Teacher-Preparation Program.

AGRICULTURE-EDUCATION (AG-Ed) 92. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL AGRICULTURE. Mr. Little. Open only to Seniors in Agricultural Teacher Preparation. 3 lec.; 3 cr.

ART-EDUCATION (ART-Ed) 91. PROBLEMS OF TEACHING ART IN ELEMENTARY SCHOOLS. Mr. Thomas. Open only to Seniors in Art Education Curriculum. 3 cr.

ART-EDUCATION (ART-Ed) 92. PROBLEMS OF TEACHING ART IN SECONDARY SCHOOLS. Mr. Thomas. Open only to Seniors in Art Education Curriculum. 3 cr.

BIOLOGY-EDUCATION (BI-Ed) 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY. 3 cr.

ENGLISH-EDUCATION (ENG-Ed) 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL ENGLISH. 3 cr.

GENERAL SCIENCE-EDUCATION (GS-Ed) 91. PROBLEMS IN THE TEACHING OF GENERAL SCIENCE. 3 cr.

HISTORY-EDUCATION (HIST-Ed) 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HISTORY. 3 cr.

HOME ECONOMICS-EDUCATION (HE-Ed) 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HOME ECONOMICS. Mrs. McLaughlin. Open only to Seniors in Home Economics Teacher-Preparation Curriculum. 3 cr.

LANGUAGE-EDUCATION. (LANG-Ed) 91. PROBLEMS IN THE TEACHING OF FOREIGN LANGUAGES IN THE HIGH SCHOOL. Mr. Boulay. 3 cr.

LATIN-EDUCATION (LAT-Ed) 91, 92. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL LATIN. Mr. Walsh. 3 cr.

MATHEMATICS-EDUCATION (MATH-Ed) 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL MATHEMATICS. Mr. Perkins. 3 cr.

PHYSICAL EDUCATION (P-E) 91. PROBLEMS IN THE TEACHING OF PHYSICAL EDUCATION FOR WOMEN. Miss Beckwith. 4 cr.

## COURSES IN SUPERVISED TEACHING

This work is required in the Teacher-Preparation Program. It is open only to students whose applications are approved by the Chairman of the Department of Education and the Supervisor of Student Teaching in the subject or subjects in which the applicant desires to do supervised teaching. Applications should be filed in the office of the Department of Education on or before November 15 of the academic year in which the supervised teaching is to be done. No applications for supervised teaching in academic subjects will be considered unless the applicant has completed with a grade of at least C the following courses in Education: 42, 51, 52 and 61. and, with an average grade of C or better, at least 18 semester credits in the subject-matter field in which he desires to teach under supervision. The applicant must also complete with a grade of at least C a course in the problems of teaching the subject in which he desires to do supervised teaching.

Students may be enrolled for from 6 to 12 credits of work in Supervised Teaching in the second semester of the academic year. Students may count no more than 9 semester credits in Supervised Teaching toward the fulfillment of the major requirements in Education.

EDUCATION-AGRICULTURE (AG-ED) 93. SUPERVISED TEACHING IN HIGH-SCHOOL AGRICULTURE. *Prereq.*: Senior standing in Ag-Ed Curriculum.

EDUCATION-ART (ED-ART) 94. SUPERVISED TEACHING IN SECONDARY SCHOOL ART. *Prereq.*: Art-Ed. 92.

EDUCATION-BIOLOGY (ED-BI) 93, 94. SUPERVISED TEACHING IN HIGH-SCHOOL BIOLOGY. *Prereq.*: Bi-Ed 91.

EDUCATION-COMMERCE (ED-Co) 94. SUPERVISED TEACHING IN HIGH-SCHOOL COMMERCIAL SUBJECTS.

EDUCATION-ECONOMICS (ED-ECON) 94. SUPERVISED TEACHING IN HIGH-SCHOOL ECONOMICS. *Prereq.*: Hist-Ed. 91

EDUCATION-ENGLISH (ED-ENG) 94. SUPERVISED TEACHING IN HIGH-SCHOOL ENGLISH. *Prereq.*: Eng-Ed 91.

EDUCATION-LANGUAGE (ED-LANG) 94. SUPERVISED TEACHING IN HIGH-SCHOOL FRENCH. *Prereq.*: Lang-Ed 91.

EDUCATION-GENERAL SCIENCE (ED-GS) 94. SUPERVISED TEACHING IN GENERAL SCIENCE. *Prereq.*: GS-Ed 91.

EDUCATION-HISTORY (ED-HIST) 94. SUPERVISED TEACHING IN HIGH-SCHOOL HISTORY. *Prereq.*: Hist-Ed 91.

EDUCATION-HOME ECONOMICS (ED-HE) 94. SUPERVISED TEACHING IN HIGH-SCHOOL HOME ECONOMICS. *Prereq.*: HE-Ed 91.

EDUCATION-LATIN (ED-LAT) 94. SUPERVISED TEACHING IN HIGH-SCHOOL LATIN.

EDUCATION-MATHEMATICS (ED-MATH) 94. SUPERVISED TEACHING IN HIGH-SCHOOL MATHEMATICS. *Prereq.*: Math-Ed 91.

EDUCATION-PHYSICAL EDUCATION (ED-PE) 93, (93). DIRECTED TEACHING IN PHYSICAL EDUCATION.

EDUCATION-PHYSICAL EDUCATION (ED-PE) 94. SUPERVISED TEACHING OF PHYSICAL EDUCATION IN THE FIELD.

EDUCATION-SOCIOLOGY (ED-Soc) 94. SUPERVISED TEACHING IN HIGH-SCHOOL SOCIOLOGY. *Prereq.*: Hist-Ed 91.

#### \*ELEMENTARY EDUCATION

66. WORKSHOP IN ELEMENTARY SCHOOL ART AND MUSIC. 4 cr.

67. CHILDREN'S LITERATURE. 1 cr.

84. WORKSHOP IN THE TEACHING OF ENGLISH IN UPPER ELEMENTARY SCHOOLS. 4 cr.

90. WORKSHOP IN READING AND OTHER LANGUAGE ARTS. 4 cr.

91. THE TEACHING OF ARITHMETIC. 3 cr.

93. THE TEACHING OF ELEMENTARY-SCHOOL SCIENCE. 3 cr.

94. WORKSHOP IN UPPER-GRADE LANGUAGE ARTS AND TECHNIQUES OF PUPIL ORGANIZATION. 4 cr.

95. WORKSHOP IN PRINCIPLES AND PRACTICES OF ELEMENTARY EDUCATION. 3 cr.

96. THE IMPROVEMENT OF READING. 3 cr.

97. WORKSHOP IN SUPERVISION OF THE ELEMENTARY SCHOOL. 3-6 cr.

98. WORKSHOP IN ELEMENTARY-SCHOOL CURRICULUM PROBLEMS. 3 cr.

#### ELECTRICAL ENGINEERING

L. W. HITCHCOCK, *Chairman*

To become a candidate for a Master's Degree in Electrical Engineering a student should have completed work in his major

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\*Courses in elementary education are normally offered only during the Summer Session.

field equivalent to that required of undergraduates at the University of New Hampshire. One copy of the thesis is required by the department.

58. COMMUNICATIONS. Analysis and design of the components of Communication Systems. Performance tests on receivers, transmitters, power amplifiers, and other elements of radio, television, carrier current, and speech amplifying systems. 3 rec.; 1 lab.; 4 cr.

60. ADVANCED CIRCUIT THEORY. Steady state and transient analysis, derivation of fundamental formulas and constants. 3 rec.; 1 conference period; 4 cr.

78. ADVANCED ELECTRONICS. Frequency modulation, U.H.F. tubes, U.H.F. measurements, special wave forming circuits, and problems in transients. 3 rec.; 1 lab.; 4 cr.

101, 102. ELECTRIC AND MAGNETIC CIRCUITS. A treatment of unbalanced circuits by the use of symmetrical components. Transformer and reactor analysis. 3 rec.; 3 cr.

103, 104. PROPAGATION OF ELECTRO-MAGNETIC WAVES. Electromagnetic fields and wave guides. 3 rec.; 3 cr.

105. ADVANCED COMMUNICATIONS. Special topics in communications engineering selected in consultation with students. 3 rec.; 1 lab.; 4 cr.

107, 108. TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER. Line characteristics, lightning protection, grounding, relaying, networks, application of network protectors, limiters, fuses, capacitors, and arresters. 3 rec.; 3 cr.

THESIS. Credits to be arranged. 6-10 cr.

## ENGLISH

SYLVESTER H. BINGHAM, *Chairman*

A candidate for the degree of Master of Arts in English must present an academic record that shows he is prepared for advanced work in English and American literature. He must pass the written examination on English and American literature which is required of undergraduate majors in English unless he has previously passed it or its equivalent. This requirement must be fulfilled before beginning the thesis.

Special requirements for the Master's Degree: The student who is a candidate for a Master's Degree in English must earn 30

credits; no more than 12 in literature courses open to undergraduate students (those numbered 51-99) at least 12 in literature courses primarily for Graduate Students (those numbered 101-199), and 6 credits in a thesis.

A reading knowledge of French, German, or Latin is required of the candidate.

A student taking a course primarily for Graduate Students must register for the graduate course and pass, in partial fulfillment, with a grade of B or better, the corresponding 51-90 undergraduate course; at the same time he must do additional work assigned by his instructor and prepare a paper on an agreed subject connected with his study. An account of the additional work must be turned in to the Chairman of the Department no later than two weeks after the commencement of the course, and the paper must be in the hands of the Chairman at least two weeks before the end of the course. A student may not register for a graduate course if he has previously taken the corresponding undergraduate course.

55, 56. CHAUCER. 3 lec.; 3 cr.

57, 58. SHAKESPEARE'S PLAYS. The major histories, comedies, and tragedies. Mr. Hennessy. 3 lec.; 3 cr.

59. MILTON. Mr. Schultz. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

60. BOSWELL'S JOHNSON. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

61. WORDSWORTH. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

62. BROWNING. Mr. Daggett. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

63, 64. ENGLISH LITERATURE IN THE SIXTEENTH CENTURY. Mr. Schultz. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

65, 66. ENGLISH LITERATURE IN THE SEVENTEENTH CENTURY. Mr. Towle. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

67, 68. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY. Mr. Maynard. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

69, 70. THE ENGLISH ROMANTIC PERIOD. Wordsworth, Coleridge, Lamb, Byron, Shelley, Keats, Hazlitt, DeQuincy. Mr. Daggett. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)



71, 72. VICTORIAN PROSE AND POETRY. Major non-fictional prose from Carlyle to Stevenson and major poetry from Tennyson to Hardy. Mr. Hennessy. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

73, 74. BRITISH LITERATURE OF THE TWENTIETH CENTURY. Mr. Daggett. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

75. NEW ENGLAND RENAISSANCE. Emerson, Thoreau, and other transcendentalists. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

76. AMERICAN NOVEL IN THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

77. AMERICAN POETRY OF THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

78. AMERICAN HUMOR AND SATIRE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

79, 80. AMERICAN LITERATURE OF THE TWENTIETH CENTURY. Mr. Towle. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

81-82. INTRODUCTION TO ENGLISH DRAMA. The development of English drama, exclusive of Shakespeare, from the Middle Ages to the present. Mr. Hennessy. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

83-84. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES. Mr. Bingham. 3 lec.; 3 cr. Alternate years; offered in 1950-51.)

\*85, 86. A SURVEY OF ENGLISH AND AMERICAN LITERATURE. The Department, under the direction of the Chairman. 3 lec.; 3 cr.

155, 156. CHAUCER. 3 lec.; 3 cr.

157, 158. SHAKESPEARE. 3 lec.; 3 cr.

159. MILTON. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

160. BOSWELL'S JOHNSON. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

161. WORDSWORTH. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

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\*This course cannot be counted toward the Master's degree.

162. BROWNING. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

163, 164. ENGLISH LITERATURE IN THE SIXTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

165, 166. ENGLISH LITERATURE IN THE SEVENTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

167, 168. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

169, 170. THE ENGLISH ROMANTIC PERIOD. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

171-172. VICTORIAN PROSE AND POETRY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

173, 174. BRITISH LITERATURE OF THE TWENTIETH CENTURY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

175. THE NEW ENGLAND RENAISSANCE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

176. THE AMERICAN NOVEL IN THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

177. AMERICAN POETRY OF THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

178. AMERICAN HUMOR AND SATIRE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

179, 180. AMERICAN LITERATURE OF THE TWENTIETH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

181, 182. AN INTRODUCTION TO ENGLISH DRAMA. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

183, 184. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

## ENTOMOLOGY

JAMES G. CONKLIN, *Chairman*

Students majoring in this department are expected to have had adequate preparation in undergraduate entomology and related sciences. Students lacking the necessary background courses may be required to complete certain courses which do not carry graduate credit before they are admitted to candidacy for a degree.

The program of graduate study is designed to meet the needs of those students who are planning to take further work leading to a career in professional Entomology.

A thesis is required of all candidates for the Master's Degree in Entomology.

54. MEDICAL ENTOMOLOGY. Insects and arachnids in relation to public health. The more important disease carriers, their biologies, and means of control. Adapted especially for students who are interested in public health or medicine. Mr. Blickle. 2 lec.; 1 lab.; 3 cr.

56. FOREST INSECTS. Principles of Forest Entomology. Life histories and habits of more destructive forest insects. Forest insect control. Adapted especially for forestry students. Mr. Conklin. *Prereq.*: Ent. 2. 1 lec.; 2 cr.

57-58. ADVANCED ENTOMOLOGY. The anatomy and physiology of insects. Systematic Entomology. Mr. Conklin, Mr. Blickle. Open to others than Entomology majors by permission of the Chairman of the Department. 2 lec.; 2 lab.; 4 cr.

59-60. ADVANCED ECONOMIC ENTOMOLOGY. Problems in applied Entomology. The literature of Economic Entomology. Investigational methods. Studies of the specialized phases of Entomology. Mr. Conklin, Mr. Blickle. Required of Entomology majors. Open to others than Entomology majors by permission of the Chairman of the Department. 1 to 3 cr.

101, 102. GRADUATE ENTOMOLOGY. Mr. Conklin, Mr. Blickle. Hours and credits to be arranged.

103, 104. GRADUATE ENTOMOLOGY. THESIS. Mr. Conklin, Mr. Blickle. Hours and credits to be arranged.

## GOVERNMENT

NORMAN ALEXANDER, *Chairman*

An applicant for admission to Graduate work in Government must have completed 24 semester credits of work in the Social Sciences including a minimum of 12 credits in Government with an average grade of B or the equivalent in his government courses.

A candidate for the degree of Master of Arts in Government is required to complete at least 30 credits of work with a minimum of 18 credits in government courses numbered 101 - 199 including the thesis; at least 3 credits in government courses numbered 51 - 99; and a maximum of 9 credits in courses offered by related departments and numbered 51 - 199.

51, 52. CONSTITUTIONAL LAW. A case study of the American Constitution, stressing the powers of Congress and the President. The Bill of Rights, limitations upon state legislation, and the nature of the judicial process. Consideration is given to the economic and social aspects of constitutional law principles. Mr. Alexander. 3 lec. or rec.; 3 cr.

55. WORLD POLITICS. The nature of the international community and the foundations of national power. An analysis of the major forces which influence contemporary world politics, including nationalism, imperialism, international economics, population problems, ideological differences, and the techniques of total war. Emphasis is placed on the critical areas in the present East-West power struggle, including the Far East, the Near East, and Western Europe. Mr. Kuusisto. 3 lec. or rec.; 3 cr.

56. INTERNATIONAL LAW AND ORGANIZATION. This course has a double aim: to analyze the rules governing the conduct of states and to examine existing international organizations, both within and outside the United Nations. An analysis of the United Nations and its subsidiary organizations, as well as the defunct League of Nations and its agencies, is made in terms of their effectiveness in bringing law and order to the international community. The policies of the Great Powers toward major issues of both international law and organization are examined. Mr. Kuusisto. 3 lec. or rec.; 3 cr.

57. PUBLIC ADMINISTRATION. An examination of concepts and relationships involved in getting the job done in government. Material covers the expansion and present scope of government administration; the enlarged responsibility to the public which rests upon the modern administrator; organization, co-ordination, and planning as tools of management; personnel, finance, and other selected administrative techniques. Mr. Deming. *Prereq.*: Permission of instructor. 3 lec. or rec.; 3 cr.

58. PROBLEMS OF PUBLIC ADMINISTRATION. An extension of the theory and techniques of Govt. 57 as applied in the operating areas of administrative practice. Material includes an appraisal of bureaucracy and the function of administration in a democracy; the chief types of administrative organization; the administrative process: administrative procedure, management, analysis, control, and responsibility. Mr. Deming. *Prereq.*: Govt. 57. 3 lec. or rec.; 3 cr.

60. GOVERNMENT APPRENTICESHIP. Designed to give the student a practical concept of local and state government administration. At least two afternoons a week will be spent working under

the supervision of a public official in a unit of state or local government. The student will be assigned to the Bureau of Government Research service projects which are designed to assist the public official under whom the student is working. The student will be expected to acquaint himself with the instructional materials available in his field of apprenticeship. Periodic reports will be required. Mr. Deming. *Prereq.*: Govt. 57 and permission of the instructor. 4 cr.

61. LABOR LAW. An analysis of the development and the interpretation of the major laws regulating labor. The principal topics deal with legislation relating to the legal position of labor unions; the policies of organized labor; unfair labor practices by employers and employees; collective bargaining; democracy within labor unions. Consideration is given to the economic and political effects of such legislation upon labor and management and to the impact of labor laws upon the ideal of the democratic process. Mr. Alexander. 3 lec. or rec.; 3 cr.

63. POLITICAL THOUGHT IN THE WEST. A survey of the principal political theories from Plato and Aristotle to the beginning of the modern liberal tradition. The course is designed to show the growth and development of political thinking and institutions in terms of the development of modern government. Special emphasis will be given to the development of the modern nation state and to its fundamental institutions. Mr. Holden. 3 lec. or rec.; 3 cr.

64. MODERN POLITICAL THOUGHT. A survey of modern Western political thought from the emergence of the nation state to the present. Special attention will be given to the meaning and growth of the basic patterns of thought on the Continent and in England, including liberalism, democracy, socialism, communism, fascism, and nazism. American political thought will be traced from its English and European origins, stressing the more modern developments in federalism, judicial review, centralization, separation of powers, etc. Mr. Holden. 3 lec. or rec.; 3 cr.

65, 66. RESEARCH IN GOVERNMENT PROBLEMS. An individual research project in one of the fields of government, *e.g.*; local or state administration, comparative government, international relations, international organization, political theory, politics, or public law to be prepared under the direction of a member of the staff. Emphasis will be placed on the methods and sources of research in government. The department staff. 3 cr.

101. THE LEGISLATIVE PROCESS. A study of the law-making process and the forces which shape legislation, including a com-

parison of legislative procedures of federal, state, and local law-making bodies. Mr. Holden. *Prereq.*: Permission of the instructor. 3 cr.

105. SEMINAR IN WORLD POLITICS. A detailed analysis of the major forces and factors influencing the development of modern world politics. Discussion of individual topics selected by students of the seminar; preparation of theses, and oral reports in the field of international relations and world politics. Mr. Kuusisto. *Prereq.*: Permission of the instructor.

108. SEMINAR IN PUBLIC MANAGEMENT. A study of special management and administrative problems through use of individual research on specific problems, round-table discussions with public officials, and individual conferences. Attention will be given to problems of municipal management as well as to state and federal administration. Mr. Deming. *Prereq.*: Permission of the instructor. 3 cr.

## HISTORY

PHILIP M. MARSTON, *Chairman*

The candidate for admission who intends to work for the Degree of Master of Arts in History should present evidence of having satisfactorily completed at least 24 semester credits, as an undergraduate, in courses in History, not including courses open to Freshmen, with a grade of C or better. The requirements for the Degree of Master of Arts in History are those stated on page 13 of this announcement of the Graduate School. The completed thesis must be submitted by May first of the year in which the degree is to be granted.

51. 52. COLONIAL AND REVOLUTIONARY AMERICAN HISTORY. Colonial beginnings in America, national rivalries, the English colonies, the Revolution, and our national life to 1789. Early forms of Americanism in the making. Mr. Marston. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

59. 60. SOCIAL AND CULTURAL HISTORY OF NEW ENGLAND. From the settlements to the present. The material and intellectual aspects peculiar to New England's social and cultural life. The viewpoint is partly that of the antiquarian. Source materials figure considerably. It is assumed that the student is familiar with the general history of New England. Mr. Marston. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

63, 64. RECENT WORLD HISTORY. The world from the First World War, exclusive, for the most part, of American affairs, and stressing historical developments in Europe, the Near East and Far East. Mr. Yale. 3 lec. or rec.; 3 cr.

71, 72. HISTORY OF RUSSIA. A study of Tsarist Russia, its domestic and foreign affairs, and its collapse in 1917; followed by a study of Soviet Russia from the creation of the Soviet Union to the present. Mr. Yale. 3 lec. or rec.; 3 cr.

83, 84. THE FOREIGN RELATIONS OF THE UNITED STATES. Although primarily a study in the history of American diplomacy, as much attention as possible is given to the non-diplomatic aspects of foreign relations. Mr. Long. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

85, 86. TWENTIETH CENTURY AMERICA. A study of the history of the United States since 1890. Emphasis is placed on economic discontent and political protest from the Populist Revolt to date; and on the world conditions changing and molding United States foreign policy. Mr. Long. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

87, 88. THE INTELLECTUAL HISTORY OF WESTERN CIVILIZATION. The history of ideas and of great epochs in human thought. A study of the dominant characters of the leading cultures and of the transitions from one to the other. The content of the course will be selective rather than inclusive. Special attention will be given to a study of some of the major source writings of each period. Mr. Johnson. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

HISTORY-EDUCATION (HIST-ED). 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HISTORY AND OTHER SOCIAL STUDIES. Bibliography and new interpretations of history; the social studies curriculum, past and present; aims and objectives in the social studies; selection and organization of teaching material; teaching and testing techniques. Special emphasis on teaching American History and the Problems of American Democracy. Mr. Long. Open to students who have satisfactorily completed Hist. 7, 8; six credits in other history courses, exclusive of Hist. 1, 2; six credits from Govt. 1, Econ. 1, or Soc. 1; and Ed. 61 with a grade of C or better. 3 lec. or rec.; 3 cr.

111, 112. SEMINAR IN THE HISTORY OF NEW ENGLAND. For Graduate Students who wish to specialize in some phase of New England history or the history of New Hampshire. The work is concerned primarily with the study and interpretation of source

material and can be correlated with the preparation of a thesis. Mr. Marston. *Prereq.*: Permission of the instructor. 3 cr. (Alternate years; not offered in 1950-51.)

113, 114. SOURCES FOR THE STUDY OF COLONIAL AMERICAN HISTORY. For students who have taken Hist. 51, 52 or the equivalent. Training in the methods of historical investigation and in the use of sources in the field of Colonial American History. The preparation of papers based on source materials alone. Mr. Marston. *Prereq.*: Permission of the instructor. 3 cr. (Alternate years; offered in 1950-51.)

123, 124. HISTORIOGRAPHY. The lives and writings of some leading historians from earliest times to the present, and their contributions to scope, method, viewpoint, and literary achievement. Mr. Partridge. *Prereq.*: Permission of the instructor. 3 cr.

## HORTICULTURE

ALBERT F. YEAGER, *Chairman*

Students will find the department well equipped for fundamental research on horticultural problems. In addition to the general requirements for all Graduate Students, basic chemistry and plant science courses equivalent to those ordinarily required for a Bachelor's Degree in Horticulture are prerequisites for registration as a Graduate Student in Horticulture.

53. POMOLOGY: ORCHARD FRUITS. Fundamental principles and experimental data and their applications to orchard problems including the establishment of orchards, soil management, water and fertilizer requirements, mineral deficiencies, training and pruning, fruit bud formation, pollination and fruits setting, thinning and winter injury. Mr. Latimer.. 3 lec.; 3 cr.

54. POMOLOGY: SMALL FRUIT CULTURE. The culture and economic uses of the strawberry, raspberry, blackberry, blueberry, and grape. Each fruit is considered with relation to its history, propagation, planting, pruning, harvesting, marketing, insects and diseases, and domestic uses. Mr. Latimer. 2 lec.; 2 cr.

55. SYSTEMATIC SURVEY OF FRUITS. Important species and their botanical relationships. The history, distribution, and merits of each species. and the horticultural varieties developed from it. Mr. Latimer. *Prereq.*: Bot. 1. 2 lec.; 2 cr.

57. SYSTEMATIC SURVEY OF VEGETABLES. Important species of vegetables and culinary herbs and their botanical relationships.



The history, distribution, and commercial merit of each species and the horticultural varieties developed from it. Mr. Hepler. 2 lec.; 2 cr.

58. ERICACEOUS FRUITS. A course designed to cover both highbush and lowbush blueberries and cranberries, including culture, propagation, harvesting, and marketing. For majors in Horticulture. Mr. W. W. Smith. 2 lec.; 2 cr.

65. COMMERCIAL VEGETABLE PRODUCTION. The management of commercial vegetable gardens. Important vegetables and their culture including a comprehensive review of recent experimental work. Mr. Hepler. *Prereq.*: Hort. 14. 2 lec.; 1 lab.; 3 cr.

91, 92. HORTICULTURE SEMINAR. A review of recent Horticultural literature and methods of investigational work. Students are required to prepare and present papers on selected topics. Department staff. Mr. W. W. Smith. 1 lec.; 1 cr.

94. PLANT BREEDING. Application of the principles of genetics to practical plant breeding. Hybridization, chemical treatments, and selection as means of producing and improving varieties. Mr. Yeager. *Prereq.*: Zool. 49. 2 lec.; 1 lab.; 3 cr.

101-102. METHODS OF PLANT RESEARCH. A study of the methods used in laboratory and field in plant investigations including scientific equipment such as potentiometers, thermocouples, geiger counters, refractometers, spectrophotometers, etc., and their use; project outlines, bibliographies, procedures, interpretation of data and statistical analysis of results. Mr. Eggert and staff. *Prereq.*: Agr. Chem. 2. 2 rec.; 2 cr.

103. NUTRITION OF HORTICULTURAL PLANTS. The effect of soil management, fertilizers, mulching materials, and mineral deficiencies on the functioning and performance of horticultural plants. Mr. Latimer. *Prereq.*: Agron. 1, Agr. Chem. 2. 2 rec.; 2 cr.

104. ASEXUAL PROPAGATION OF PLANTS. The making, dissection, and critical examination of grafts, buds, cuttings, and layers of clons, especially as applied to fruit stocks. A study of regeneration, orientation, and compatibility of plant tissues. Mr. W. W. Smith. *Prereq.*: Agr. Chem. 2, Bot. 4. 2 rec.; 2 cr.

105. FLOWER BUD FORMATION, POLLINATION AND FRUIT SETTING. The influence of natural environmental factors, soil management, orchard fertilization, and resultant chemical composition of fruit plants on flower bud formation and alternate bearing; also, the effect of these and genetical factors on the production of fruit. Mr. Latimer. *Prereq.*: Agr. Chem. 2, Bot. 1-2, Zool. 49. 2 lec.; 1 lab.; 3 cr.

109. INHERITANCE IN HORTICULTURAL PLANTS. Inheritance in various horticultural crops, a review of literature, and an analysis of the future breeding possibilities of each crop. Mr. Yeager. *Prereq.*: Elementary genetics and plant breeding. 3 lec.; 3 cr.

125, 126. RESEARCH IN HORTICULTURE. Mr. Yeager and staff. *Prereq.*: Hort. 102. (May be taken concurrently.) Credits to be arranged.

## LANGUAGES

ERNEST A. BOULAY, *Chairman*

To be admitted to candidacy for the Degree of Master of Arts in Languages, the student must have met requirements substantially equal to those set up for the fulfillment of an undergraduate major in Languages at the University of New Hampshire.

The student must submit an acceptable thesis embodying the results of independent investigation (equivalent to 6 to 9 semester credits in courses primarily for Graduate Students) and may be required to pass a special oral or written examination, at the end of the period of graduate study, in the language and literature of his field of specialization.

No more than 6 semester credits may be earned for courses outside this department.

A Graduate Student in Languages may take all his work in one language or in combinations of courses in two of the following languages: French, German, Latin, Spanish. Courses in General Language and Literature, listed below, may be counted towards the degree.

### GENERAL LANGUAGE AND LITERATURE

51, 52. SURVEY OF MODERN EUROPEAN LITERATURE. The Renaissance, classicism, romanticism, and realism studied as international movements. Stress will be laid, not upon the details of each national literature, but upon the interdependence of the literature of the various countries. Conducted in English. 3 rec.; 3 cr. (Alternate years; not offered in 1950-51.)

73-74. GENERAL INTRODUCTION TO THE SCIENCE OF LANGUAGE. An introduction to the science of linguistics. The origins of language; the languages of the world, phonology; morphology; syntax; semantics; entymology; language and writing; the science of comparative philology and its development; dialect divergence; the principles of linguistic change, race culture, and language; the psychology of language. The course, though designed particularly for majors in English or other languages, is open to all

Graduate Students. 3 lec.; 3 cr. Alternate years; not offered in 1950-51.)

LANGUAGES-EDUCATION (LANG-ED) 91. PROBLEMS IN THE TEACHING OF MODERN LANGUAGE IN THE HIGH SCHOOL. The special objectives, methods, and devices of modern language teaching in high schools. For prospective or actual teachers of French, German, and Spanish. Mr. Boulay. *Prereq.*: Ed. 61 with grade of C or better and one of the following courses: French 6, German 4, Spanish 4. 3 rec.; 3 cr.

## FRENCH

61-62. ADVANCED FRENCH GRAMMAR AND COMPOSITION. A systematic study of French grammar with much oral and written practice. For students who wish to perfect their command of written and spoken French. Mr. Faulkner. *Prereq.*: French 6. (Students are advised to have had French 13-14 or the equivalent). 3 rec.; 3 cr.

63-64. FRENCH LITERATURE AND CIVILIZATION OF THE MIDDLE AGES AND THE RENAISSANCE. The various forms and masterpieces of French literature from the beginning to the year 1600. Recommended for Seniors and Graduate Students. Mr. Parker. *Prereq.*: French 12 or 54. 2 lec.; 2 cr. (Alternate years; not offered in 1950-51.)

92. ORAL FRENCH. Accuracy and facility in the use of oral French will be attempted through the study of phonetics and the use of dictation, conversation, the phonograph, and other devices. Mr. Boulay. *Prereq.*: May be taken concurrently with French 61-62 or after completion of French 14 or 62. 3 rec.; 3 cr.

101, 102. HISTORY OF FRENCH LITERATURE. This course is not an introduction to French literature, but complements what the student has previously learned. In general, each student is expected to study more carefully the authors of whom he has some knowledge, to fill in the gaps between courses he has taken, and to obtain an integrated knowledge of all French literature. Mr. Parker. *Prereq.*: Permission of Chairman of Department. 3 cr.

103, 104. SPECIAL STUDIES IN FRENCH LITERATURE. Individual guided study in special topics, with training in bibliography, note-taking, and organization of material. Examples of topics which may be selected by instructor and student in conference are: (a) Corneille and his critics; (b) the work of Jean-Jacques Rousseau; (c) the theater in the eighteenth century; (d) twentieth-century French literature; (e) French-Canadian literature. Mr. Parker,

Mr. Faulkner, Mr. Boulay. *Prereq.*: Permission of Chairman of Department. 3 cr.

111, 112. FRENCH LITERATURE OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES. 3 rec.; 3 cr. Mr. Parker. (Alternate years; not offered in 1950-51.)

153, 154. FRENCH LITERATURE OF THE NINETEENTH AND TWENTIETH CENTURIES. Romanticism, realism, the Parnassian school, naturalism, the reaction against naturalism, symbolism, and certain individual writers of the twentieth century. 3 rec.; 3 cr. Mr. Parker. (Alternate years; offered in 1950-51.)

## GERMAN

57-58. MODERN GERMAN LITERATURE. The works of Grillparzer, Hebbel, Ludwig, Keller, Meyer, Hauptmann, Suderman, as well as those of other authors whose activity extends to the present time. Mr. Lepke. *Prereq.*: German 4. 3 rec.; 3 cr. (Alternate years; not offered in 1950-51.)

63-64. HISTORY OF GERMAN CULTURE. Its development from pagan to modern times. Representative works read in and out of class. The history of German civilization is taken up parallel with the history of literature. Mr. Lepke. *Prereq.*: Two years of college German or the equivalent. 3 class hours: 3 cr. Alternate years; offered in 1950-51.)

103, 104. SPECIAL STUDIES IN GERMAN LITERATURE. Individual guided study in special topics, with training in bibliography, note-taking and organization of material. Examples of topics which may be selected by instructor and student in conference are: (a) Middle High German; (b) the Renaissance; (c) Goethe; (d) German Romanticism; (e) twentieth-century German literature. Mr. Danoff. Mr. Lepke. *Prereq.*: Permission of Chairman of Department. 3 cr.

## LATIN

55-56. LITERATURE AND HISTORY. A comprehensive view of Latin Literature of the Golden Age, particularly the works of Caesar, Cicero, and Virgil. Literary value and historical content will be studied as well as such background of the history of Rome during the period as is necessary for the student or teacher of the classics. Mr. Walsh. *Prereq.*: Latin 6. 3 rec.; 3 cr. (Alternate years; not offered in 1950-51.)

LATIN-EDUCATION (LAT-ED) 91-92. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL LATIN. The study of methods, objectives, and

problems of teaching high-school Latin will be carried on throughout the year concurrently with work in composition and conversation. *Prereq.*: Permission of the instructor. 3 rec.; 3 cr. (Alternate years; offered in 1950-51.)

101, 102. HISTORY OF LATIN LITERATURE. A study of Latin Literature through the medium of selections from the works of the more important authors from the beginning to the decline of literary Latin. This reading will be supplemented by a detailed study of some special field, author, or group of authors. Mr. Walsh. *Prereq.*: Permission of the instructor. 3 rec.; 3 cr.

## SPANISH

55-56. LATIN-AMERICAN LITERATURE. Selected writers of Latin-American countries who illustrate literature and social conditions in Central and South America. Certain works will be discussed in class while others will be assigned for collateral reading. Mr. Berzunza. *Prereq.*: Spanish 4. 3 rec.; 3 cr. (Alternate years; offered in 1950-51.)

101, 102. SPANISH LITERATURE OF THE MIDDLE AGES. Masterpieces and writers of Spanish Literature from the beginning to 1500. Their historical background. Conducted as far as possible in Spanish. Mr. Berzunza. *Prereq.*: 3 years of college Spanish or equivalent; 3 lec.; 3 cr.

103, 104. SPECIAL STUDIES IN SPANISH LITERATURE. Individual guided study in special topics, with training in bibliography, note-taking, and organization of material. Examples of topics which may be selected by instructor and student in conference are: (a) eighteenth, nineteenth, or twentieth century literature in Spain; (b) literature and civilization in Spain in Golden Age; (c) the literature of individual Latin-American countries; (d) literary relations of Europe and Latin-America. Mr. Berzunza, Mr. Boulay. *Prereq.*: Permission of Chairman of Department. 3 cr.

## MATHEMATICS

DENNIS B. AMES, *Chairman*

To be admitted to graduate study in Mathematics, a candidate must have satisfactorily completed: (1) 12 semester hours in undergraduate courses in differential and integral calculus and differential equations, (2) at least 6 semester hours in more advanced undergraduate courses in Mathematics, including Advanced Calculus or its equivalent. If among these more advanced courses any prerequisites are lacking, the candidate may be required to include them in his program without credit toward the degree.

Graduate study in Mathematics is intended to provide a broad and sound training in the fundamentals. The student will, in general, be expected to include in his program, courses in analysis, algebra, and geometry.

61-62. HIGHER ALGEBRA. Theory of equations; polynomials, determinants, matrices, linear equations, linear transformation, group theory, vector spaces. *Prereq.*: Math. 18. 3 rec.; 3 cr.

65-66. ADVANCED CALCULUS. Functions of several variables, continuity, limits; partial differentiation; multiple, line and surface integrals; uniform convergence, improper integrals; Gamma and Beta functions; Fourier series. *Prereq.*: Math. 19. 3 rec.; 3 cr.

MATHEMATICS-EDUCATION (MATH-ED) 91. The aims and values of secondary-school mathematics; the recommendations of the national committee on mathematics requirements, and the State Board requirements; the subject matter and the sequence in which it should be presented in both junior and senior high schools; techniques and instructional aids used in teaching secondary-school mathematics; errors, testing program, remedial teaching. Students preparing to teach mathematics in high school should register for this course — it is a prerequisite for Supervised Teaching in Mathematics. Lectures, assigned readings, and discussions. Mr. Perkins. *Prereq.*: Ed. 61 and Math. 16. 3 rec.; 3 cr. *May be counted as major credit only by students preparing to teach mathematics in the secondary schools.*

93-94. FUNCTIONS OF A COMPLEX VARIABLE. Complex numbers, series, analytic functions, Cauchy's theorem residues, contour integration, conformal mapping, analytic continuation, Riemann surfaces, linear differential equations, applications to boundary value problems, Fourier transforms, Laplace transform. *Prereq.*: Math. 19. 3 rec.; 3 cr.

103-104. THEORY OF FUNCTIONS OF REAL VARIABLES. The real number system; theory of point sets; fundamental theorems on continuous functions, differentiation, integration, implicit functions and differential equations; Lebesgue integration and applications; introduction to modern functional analysis. *Prereq.*: Math. 65-66 or Math. 47-48. 3 rec.; 3 cr.

105-106. DIFFERENTIAL GEOMETRY. The application of the calculus to the metric differential theory of curves and surfaces in Euclidean space; tensor analysis and Riemannian geometry. *Prereq.*: Math. 65-66. 3 rec.; 3 cr.

107-108. MODERN ALGEBRA. Abstract algebra, including theory of rings and ideals; fields and their transcendental and algebraic

extensions, valuation theory; Galois theory; algebraic numbers. *Prereq.*: Math. 61. 3 rec.; 3 cr.

109-110. ANALYTICAL MECHANICS. Statics and dynamics of particles and rigid bodies, Lagrange's equations, Hamilton's equations, transformation theory. *Prereq.*: Math. 19. 3 rec.; 3 cr.

111-112. APPLIED MATHEMATICS. Fourier series and integral, theory of boundary value problems, linear integral equations, orthogonal functions, Bessel and Legendre functions, Laplace transformation, Fourier transforms, various applied problems. *Prereq.*: Math. 65-66. 3 rec.; 3 cr.

113-114. MATHEMATICAL STATISTICS. Essentially a mathematical course in the theory of statistics. *Prereq.*: Permission of the instructor. 3 rec.; 3 cr.

## MECHANICAL ENGINEERING

EDWARD T. DONOVAN, *Chairman*

To become a candidate for a Master's Degree in Mechanical Engineering a student should have completed work equivalent to that required for a Bachelor of Science Degree in this field, at the University of New Hampshire, and should have maintained an average grade of B for his undergraduate course.

55-56. INTERNAL COMBUSTION ENGINES. The internal combustion engine, including its thermodynamics, carburetion, lubrication, and vibration. Also a consideration of the fundamental principles of the gas turbine and the jet engine. Mr. Stolworthy. *Prereq.*: M.E. 8 and 24. 2 rec.; 1 lab.; 3 cr.

65. ENGINEERING ECONOMY. The principles which form the basis of engineering procedures for obtaining the highest ratio of utility to cost. 3 rec.; 3 cr.

101, 102. ADVANCED THERMODYNAMICS. The general equations of thermodynamics and their application to fluids such as air and steam; heat transmission; current applications and advances in thermodynamics. Mr. Donovan. 3 rec.; 3 cr.

105, 106. ADVANCED MECHANICS OF MATERIALS. To review and show the limitations of the ordinary formulas of strength of materials. To consider the conditions under which these limitations hold and to extend the subject to more complex topics than those previously considered. To present a more detailed study of the concepts and methods used in the analysis of stresses in structures and machine members. Further study of stresses in plates, thick

cylinders, rotating cylinders, and shafts; stresses in curved members under flexure; stress concentrations and analysis of stresses in statically indeterminate structures by elastic strain energy and photo-elastic methods. Mr. Getchell. *Prereq.*: M.E. 8. 3 rec.; 3 cr.

## PHYSICS

FREDERIC A. SCOTT, *Chairman*

For admission to graduate work in Physics the candidate must have satisfactorily completed undergraduate courses in Physics totaling 24 to 30 semester hours. Suitable undergraduate work in mathematics is essential and should include work in differential equations. The general aim of the program will be to give the student broad general training in fundamentals. To accomplish this some intermediate courses numbered 51-99 may be required. The department requires one additional copy of the thesis.

81. OPTICS. Geometrical and physical optics, refraction, lens systems, wave theory of light, diffraction, interference, polarization, spectroscopy, etc. *Prereq.*: Phys. 21-22; Math. 19 passed or taken concurrently. 3 rec.; 1 lab.; 4 cr.

82. HEAT. Thermometry, pyrometry, calorimetry, radiation, heat conduction and thermodynamics. *Prereq.*: Phys. 21-22; Math. 19-20 passed or taken concurrently. 3 rec.; 1 lab.; 4 cr.

83-84. THEORY OF ELECTRICITY AND MAGNETISM. Electrostatics, magnetostatics, dielectric theory, electromagnetics, magnetic circuits, alternating currents, complex impedance, thermoelectricity, electromagnetic field. *Prereq.*: Phys. 21-22; Math. 19-20 passed or taken concurrently. 3 lec.; 1 lab.; 4 cr.

85-86. ADVANCED MECHANICS. An analytical treatment of classical mechanics including such topics as the methods of plane statics and dynamics and their applications, impulsive forces, oscillations, statics and dynamics in space. *Prereq.*: Math. 19-20 passed or taken concurrently. 3 rec.; 3 cr.

91-92. MODERN PHYSICAL THEORIES. Recent developments in Physics, including Maxwell's field equations, photoelectric effect, quantum theory, X-rays, relativity, nuclear theory. *Prereq.*: Phys. 83-84 or the equivalent. 3 rec.; 3 cr.

93-94. THEORETICAL PHYSICS. An introduction to the applications of mathematics to physics, including such topics as kinetic theory, elasticity, fluid mechanics, sound, theory of vibrations, etc. *Prereq.*: Math. 19 and 20. 3 rec.; 3 cr.



71, 72. VICTORIAN PROSE AND POETRY. Major non-fictional prose from Carlyle to Stevenson and major poetry from Tennyson to Hardy. Mr. Hennessy. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

73, 74. BRITISH LITERATURE OF THE TWENTIETH CENTURY. Mr. Daggett. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

75. NEW ENGLAND RENAISSANCE. Emerson, Thoreau, and other transcendentalists. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

76. AMERICAN NOVEL IN THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

77. AMERICAN POETRY OF THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

78. AMERICAN HUMOR AND SATIRE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

79, 80. AMERICAN LITERATURE OF THE TWENTIETH CENTURY. Mr. Towle. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

81-82. INTRODUCTION TO ENGLISH DRAMA. The development of English drama, exclusive of Shakespeare, from the Middle Ages to the present. Mr. Hennessy. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

83-84. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES. Mr. Bingham. 3 lec.; 3 cr. Alternate years; offered in 1950-51.)

\*85, 86. A SURVEY OF ENGLISH AND AMERICAN LITERATURE. The Department, under the direction of the Chairman. 3 lec.; 3 cr.

155, 156. CHAUCER. 3 lec.; 3 cr.

157, 158. SHAKESPEARE. 3 lec.; 3 cr.

159. MILTON. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

160. BOSWELL'S JOHNSON. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

161. WORDSWORTH. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

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\*This course cannot be counted toward the Master's degree.

162. BROWNING. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

163, 164. ENGLISH LITERATURE IN THE SIXTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

165, 166. ENGLISH LITERATURE IN THE SEVENTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

167, 168. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

169, 170. THE ENGLISH ROMANTIC PERIOD. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

171-172. VICTORIAN PROSE AND POETRY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

173, 174. BRITISH LITERATURE OF THE TWENTIETH CENTURY. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

175. THE NEW ENGLAND RENAISSANCE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

176. THE AMERICAN NOVEL IN THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

177. AMERICAN POETRY OF THE NINETEENTH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

178. AMERICAN HUMOR AND SATIRE. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

179, 180. AMERICAN LITERATURE OF THE TWENTIETH CENTURY. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

181, 182. AN INTRODUCTION TO ENGLISH DRAMA. 3 lec.; 3 cr. (Alternate years; not offered in 1950-51.)

183, 184. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES. 3 lec.; 3 cr. (Alternate years; offered in 1950-51.)

## ENTOMOLOGY

JAMES G. CONKLIN, *Chairman*

Students majoring in this department are expected to have had adequate preparation in undergraduate entomology and related sciences. Students lacking the necessary background courses may be required to complete certain courses which do not carry graduate credit before they are admitted to candidacy for a degree.

The program of graduate study is designed to meet the needs of those students who are planning to take further work leading to a career in professional Entomology.

A thesis is required of all candidates for the Master's Degree in Entomology.

54. MEDICAL ENTOMOLOGY. Insects and arachnids in relation to public health. The more important disease carriers, their biologies, and means of control. Adapted especially for students who are interested in public health or medicine. Mr. Blickle. 2 lec.; 1 lab.; 3 cr.

56. FOREST INSECTS. Principles of Forest Entomology. Life histories and habits of more destructive forest insects. Forest insect control. Adapted especially for forestry students. Mr. Conklin. *Prereq.*: Ent. 2. 1 lec.; 2 cr.

57-58. ADVANCED ENTOMOLOGY. The anatomy and physiology of insects. Systematic Entomology. Mr. Conklin, Mr. Blickle. Open to others than Entomology majors by permission of the Chairman of the Department. 2 lec.; 2 lab.; 4 cr.

59-60. ADVANCED ECONOMIC ENTOMOLOGY. Problems in applied Entomology. The literature of Economic Entomology. Investigational methods. Studies of the specialized phases of Entomology. Mr. Conklin, Mr. Blickle. Required of Entomology majors. Open to others than Entomology majors by permission of the Chairman of the Department. 1 to 3 cr.

101, 102. GRADUATE ENTOMOLOGY. Mr. Conklin, Mr. Blickle. Hours and credits to be arranged.

103, 104. GRADUATE ENTOMOLOGY. THESIS. Mr. Conklin, Mr. Blickle. Hours and credits to be arranged.

## GOVERNMENT

NORMAN ALEXANDER, *Chairman*

An applicant for admission to Graduate work in Government must have completed 24 semester credits of work in the Social Sciences including a minimum of 12 credits in Government with an average grade of B or the equivalent in his government courses.

A candidate for the degree of Master of Arts in Government is required to complete at least 30 credits of work with a minimum of 18 credits in government courses numbered 101 - 199 including the thesis; at least 3 credits in government courses numbered 51 - 99; and a maximum of 9 credits in courses offered by related departments and numbered 51 - 199.

51, 52. CONSTITUTIONAL LAW. A case study of the American Constitution, stressing the powers of Congress and the President. The Bill of Rights, limitations upon state legislation, and the nature of the judicial process. Consideration is given to the economic and social aspects of constitutional law principles. Mr. Alexander. 3 lec. or rec.; 3 cr.

55. WORLD POLITICS. The nature of the international community and the foundations of national power. An analysis of the major forces which influence contemporary world politics, including nationalism, imperialism, international economics, population problems, ideological differences, and the techniques of total war. Emphasis is placed on the critical areas in the present East-West power struggle, including the Far East, the Near East, and Western Europe. Mr. Kuusisto. 3 lec. or rec.; 3 cr.

56. INTERNATIONAL LAW AND ORGANIZATION. This course has a double aim: to analyze the rules governing the conduct of states and to examine existing international organizations, both within and outside the United Nations. An analysis of the United Nations and its subsidiary organizations, as well as the defunct League of Nations and its agencies, is made in terms of their effectiveness in bringing law and order to the international community. The policies of the Great Powers toward major issues of both international law and organization are examined. Mr. Kuusisto. 3 lec. or rec.; 3 cr.

57. PUBLIC ADMINISTRATION. An examination of concepts and relationships involved in getting the job done in government. Material covers the expansion and present scope of government administration; the enlarged responsibility to the public which rests upon the modern administrator; organization, co-ordination, and planning as tools of management; personnel, finance, and other selected administrative techniques. Mr. Deming. *Prereq.*: Permission of instructor. 3 lec. or rec.; 3 cr.

58. PROBLEMS OF PUBLIC ADMINISTRATION. An extension of the theory and techniques of Govt. 57 as applied in the operating areas of administrative practice. Material includes an appraisal of bureaucracy and the function of administration in a democracy; the chief types of administrative organization; the administrative process: administrative procedure, management, analysis, control, and responsibility. Mr. Deming. *Prereq.*: Govt. 57. 3 lec. or rec.; 3 cr.

60. GOVERNMENT APPRENTICESHIP. Designed to give the student a practical concept of local and state government administration. At least two afternoons a week will be spent working under

the supervision of a public official in a unit of state or local government. The student will be assigned to the Bureau of Government Research service projects which are designed to assist the public official under whom the student is working. The student will be expected to acquaint himself with the instructional materials available in his field of apprenticeship. Periodic reports will be required. Mr. Deming. *Prereq.*: Govt. 57 and permission of the instructor. 4 cr.

61. LABOR LAW. An analysis of the development and the interpretation of the major laws regulating labor. The principal topics deal with legislation relating to the legal position of labor unions; the policies of organized labor; unfair labor practices by employers and employees; collective bargaining; democracy within labor unions. Consideration is given to the economic and political effects of such legislation upon labor and management and to the impact of labor laws upon the ideal of the democratic process. Mr. Alexander. 3 lec. or rec.; 3 cr.

63. POLITICAL THOUGHT IN THE WEST. A survey of the principal political theories from Plato and Aristotle to the beginning of the modern liberal tradition. The course is designed to show the growth and development of political thinking and institutions in terms of the development of modern government. Special emphasis will be given to the development of the modern nation state and to its fundamental institutions. Mr. Holden. 3 lec. or rec.; 3 cr.

64. MODERN POLITICAL THOUGHT. A survey of modern Western political thought from the emergence of the nation state to the present. Special attention will be given to the meaning and growth of the basic patterns of thought on the Continent and in England, including liberalism, democracy, socialism, communism, fascism, and nazism. American political thought will be traced from its English and European origins, stressing the more modern developments in federalism, judicial review, centralization, separation of powers, etc. Mr. Holden. 3 lec. or rec.; 3 cr.

65, 66. RESEARCH IN GOVERNMENT PROBLEMS. An individual research project in one of the fields of government, e.g.; local or state administration, comparative government, international relations, international organization, political theory, politics, or public law to be prepared under the direction of a member of the staff. Emphasis will be placed on the methods and sources of research in government. The department staff. 3 cr.

101. THE LEGISLATIVE PROCESS. A study of the law-making process and the forces which shape legislation, including a com-

parison of legislative procedures of federal, state, and local law-making bodies. Mr. Holden. *Prereq.*: Permission of the instructor. 3 cr.

105. SEMINAR IN WORLD POLITICS. A detailed analysis of the major forces and factors influencing the development of modern world politics. Discussion of individual topics selected by students of the seminar; preparation of theses, and oral reports in the field of international relations and world politics. Mr. Kuusisto. *Prereq.*: Permission of the instructor.

108. SEMINAR IN PUBLIC MANAGEMENT. A study of special management and administrative problems through use of individual research on specific problems, round-table discussions with public officials, and individual conferences. Attention will be given to problems of municipal management as well as to state and federal administration. Mr. Deming. *Prereq.*: Permission of the instructor. 3 cr.

## HISTORY

PHILIP M. MARSTON, *Chairman*

The candidate for admission who intends to work for the Degree of Master of Arts in History should present evidence of having satisfactorily completed at least 24 semester credits, as an undergraduate, in courses in History, not including courses open to Freshmen, with a grade of C or better. The requirements for the Degree of Master of Arts in History are those stated on page 13 of this announcement of the Graduate School. The completed thesis must be submitted by May first of the year in which the degree is to be granted.

51, 52. COLONIAL AND REVOLUTIONARY AMERICAN HISTORY. Colonial beginnings in America, national rivalries, the English colonies, the Revolution, and our national life to 1789. Early forms of Americanism in the making. Mr. Marston. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

59, 60. SOCIAL AND CULTURAL HISTORY OF NEW ENGLAND. From the settlements to the present. The material and intellectual aspects peculiar to New England's social and cultural life. The viewpoint is partly that of the antiquarian. Source materials figure considerably. It is assumed that the student is familiar with the general history of New England. Mr. Marston. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

63, 64. RECENT WORLD HISTORY. The world from the First World War, exclusive, for the most part, of American affairs, and stressing historical developments in Europe, the Near East and Far East. Mr. Yale. 3 lec. or rec.; 3 cr.

71, 72. HISTORY OF RUSSIA. A study of Tsarist Russia, its domestic and foreign affairs, and its collapse in 1917; followed by a study of Soviet Russia from the creation of the Soviet Union to the present. Mr. Yale. 3 lec. or rec.; 3 cr.

83, 84. THE FOREIGN RELATIONS OF THE UNITED STATES. Although primarily a study in the history of American diplomacy, as much attention as possible is given to the non-diplomatic aspects of foreign relations. Mr. Long. 3 lec. or rec.; 3 cr. (Alternate years; offered in 1950-51.)

85, 86. TWENTIETH CENTURY AMERICA. A study of the history of the United States since 1890. Emphasis is placed on economic discontent and political protest from the Populist Revolt to date; and on the world conditions changing and molding United States foreign policy. Mr. Long. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

87, 88. THE INTELLECTUAL HISTORY OF WESTERN CIVILIZATION. The history of ideas and of great epochs in human thought. A study of the dominant characters of the leading cultures and of the transitions from one to the other. The content of the course will be selective rather than inclusive. Special attention will be given to a study of some of the major source writings of each period. Mr. Johnson. 3 lec. or rec.; 3 cr. (Alternate years; not offered in 1950-51.)

HISTORY-EDUCATION (HIST-ED). 91. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HISTORY AND OTHER SOCIAL STUDIES. Bibliography and new interpretations of history; the social studies curriculum, past and present; aims and objectives in the social studies; selection and organization of teaching material; teaching and testing techniques. Special emphasis on teaching American History and the Problems of American Democracy. Mr. Long. Open to students who have satisfactorily completed Hist. 7, 8; six credits in other history courses, exclusive of Hist. 1, 2; six credits from Govt. 1, Econ. 1, or Soc. 1; and Ed. 61 with a grade of C or better. 3 lec. or rec.; 3 cr.

111, 112. SEMINAR IN THE HISTORY OF NEW ENGLAND. For Graduate Students who wish to specialize in some phase of New England history or the history of New Hampshire. The work is concerned primarily with the study and interpretation of source

material and can be correlated with the preparation of a thesis. Mr. Marston. *Prereq.*: Permission of the instructor. 3 cr. (Alternate years; not offered in 1950-51.)

113, 114. SOURCES FOR THE STUDY OF COLONIAL AMERICAN HISTORY. For students who have taken Hist. 51, 52 or the equivalent. Training in the methods of historical investigation and in the use of sources in the field of Colonial American History. The preparation of papers based on source materials alone. Mr. Marston. *Prereq.*: Permission of the instructor. 3 cr. (Alternate years; offered in 1950-51.)

123, 124. HISTORIOGRAPHY. The lives and writings of some leading historians from earliest times to the present, and their contributions to scope, method, viewpoint, and literary achievement. Mr. Partridge. *Prereq.*: Permission of the instructor. 3 cr.

## HORTICULTURE

ALBERT F. YEAGER, *Chairman*

Students will find the department well equipped for fundamental research on horticultural problems. In addition to the general requirements for all Graduate Students, basic chemistry and plant science courses equivalent to those ordinarily required for a Bachelor's Degree in Horticulture are prerequisites for registration as a Graduate Student in Horticulture.

53. POMOLOGY: ORCHARD FRUITS. Fundamental principles and experimental data and their applications to orchard problems including the establishment of orchards, soil management, water and fertilizer requirements, mineral deficiencies, training and pruning, fruit bud formation, pollination and fruits setting, thinning and winter injury. Mr. Latimer.. 3 lec.; 3 cr.

54. POMOLOGY: SMALL FRUIT CULTURE. The culture and economic uses of the strawberry, raspberry, blackberry, blueberry, and grape. Each fruit is considered with relation to its history, propagation, planting, pruning, harvesting, marketing, insects and diseases, and domestic uses. Mr. Latimer. 2 lec.; 2 cr.

55. SYSTEMATIC SURVEY OF FRUITS. Important species and their botanical relationships. The history, distribution, and merits of each species, and the horticultural varieties developed from it. Mr. Latimer. *Prereq.*: Bot. 1. 2 lec.; 2 cr.

57. SYSTEMATIC SURVEY OF VEGETABLES. Important species of vegetables and culinary herbs and their botanical relationships.



animals. Living materials will be used as far as possible. Mr. Bullock, Mr. Haley. *Prereq.*: Biol. 2 and one year of Zool. 2 lec.; 2 lab.; 4 cr.

56. INVERTEBRATE ZOOLOGY. A survey of the major invertebrate groups, exclusive of insects, with emphasis on free-living forms. Evolution of various phyla and their ecological relationships. Mr. Moore. *Prereq.*: Zool. 7. 2 lec.; 2 lab.; 4 cr. (Alternate years; offered in 1950-51.)

57, (57). LABORATORY TECHNIQUE. Methods in histologic technique and examination of blood, urinary sediments, parasites, and zoological preparations. Mr. Bullock, Mr. Haley. *Prereq.*: Zool. 53 or Zool. 66 and permission of the instructor. 1 lec.; 3 lab.; 4 cr. (May be taken concurrently with Zool. 66 or 166).

59. GENERAL PHYSIOLOGY. The chemical and physical nature of the living substance. The processes of metabolism, movement of materials, irritability, response. Lectures, assigned topics, and laboratory experiments. Mr. Milne. *Prereq.*: Biol. 2, one year of Zoology, a year of college physics and a course in organic chemistry; 3 lec. or rec.; 1 lab.; 4 cr.

61. GENETICS. A study of the physical basis of inheritance, expression, and interaction of the hereditary units, linkage, and variation. The application of Mendelian principles to plant and animal breeding. Mrs. Richardson. *Prereq.*: Biol. 2, or Bot. 1 and Zool. 48. 3 lec. or rec.; 3 cr.

64. NEUROLOGY. Practical study of morphology, physiology, and histology of the human nervous system. Mrs. Richardson. *Prereq.*: Biol. 2 and one year of Zoology. 3 lec. or rec.; 1 lab.; 4 cr.

65. EMBRYOLOGY. A study of the fundamental principles of development. The developmental process from the egg to the formation of the body and the establishment of the principal organs and systems. Miss Allen. *Prereq.*: Zool. 8. 2 lec.; 2 lab.; 4 cr.

66. HISTOLOGY. This course gives the student a familiarity with the microscopical anatomy of the principal tissues and organs of vertebrates. Mr. Bullock, Mr. Haley. *Prereq.*: Zool. 8 or 18. 2 lec.; 2 lab.; 4 cr.

71-72. ECOLOGY OF THE VERTEBRATES. A study of the habitat and ecological relationships of the vertebrates with special reference to their conservation. Field methods and techniques as applied to the study of these groups will be considered. Mr. Jackson. *Prereq.*: 12 hours of Biology. 2 lec.; 2 lab.; 4 cr. (Alternate years; offered in 1950-51.)

73. **ICHTHYOLOGY.** A study of fishes; their identification, habitats, habits, economic importance, life histories with special reference to those forms occurring in eastern North America. Designed for students interested in wildlife conservation and those preparing to become aquatic biologists. Mr. Jackson. *Prereq.:* Biol. 1-2 and 8 hours of Zoology. 2 lec.; 1 lab.; 3 cr. (Alternate years; not offered in 1950-51.)

74. **HERPETOLOGY.** A study of reptiles and amphibia; their identification, habits, habitats, economic importance, life histories with special reference to those forms occurring in eastern North America. Designed for students interested in wildlife conservation. Mr. Jackson. *Prereq.:* Biol. 2, and 8 hours of Zoology. 2 lec.; 1 lab.; 3 cr. (Alternate years; not offered in 1950-51.)

87, 88. **ZOOLOGY SEMINAR.** Seminar discussions on current zoological literature conducted each week. Primarily for Seniors majoring in Zoology and for Graduate Students. Graduate Students will be required to prepare a term paper summarizing recent contributions on a particular topic. Graduate Students may present no more than 2 credits in Zoology 87, 88 in completing the 30 hours required for a Master's Degree. Mr. Moore and staff. *Prereq.:* Permission of the Department Chairman. 1 hour per week. 1 cr.

96. **LIMNOLOGY.** Factors affecting biological productivity of fresh-water lakes and streams. Adapted primarily for students interested in fish and game management, wildlife conservation and in teaching Biology. Mr. Moore. *Prereq.:* Permission of the instructor. (Alternate years; not offered in 1950-51.)

97, 98. **SPECIAL PROBLEMS.** Advanced students may elect a special problem provided they present a detailed outline of the subject and can furnish adequate proof of their ability to carry it out with equipment available. Mr. Moore and members of the staff. *Prereq.:* Permission of the Department Chairman. 1-4 cr.

101, 102. **ADVANCED VERTEBRATE TAXONOMY AND ECONOMIC FIELD ZOOLOGY.** A critical examination of selected groups of vertebrates with special reference to local forms, their classification, distribution, and general ecology and conservation. The laboratory work will deal with economic field Zoology and will consist of life history studies, detailed ecological surveys of local areas, control of injurious animals, food habit studies, census taking and studies of factors controlling animal populations. Mr. Jackson. *Prereq.:* 3 years' work in Biology. 2 lec.; 2 lab.; 4 cr. (Alternate years; not offered in 1950-51.)

111, 112. PROBLEMS IN BIOLOGY. This course involves reading, laboratory work, and conferences on special problems approved by the staff. Total of 4 credits will be presented under these numbers by those students who have been granted permission to waive the thesis requirement. Two copies of a formal report must be filed with the Department Chairman before credit is given for this course. Mr. Moore and staff. *Prereq.*: Permission of the Department Chairman. 1-4 cr.

151. PARASITOLOGY. An introductory course concerned with some of the more important parasites causing diseases of man and animals. This course will meet with Zool. 51. Students will be expected to do extra reading and laboratory work. Not open to students who have credit for Zool. 51. Mr. Bullock. *Prereq.*: 14 hours of Zoology. 2 lec.; 2 lab.; 4 cr.

152. ADVANCED PARASITOLOGY. A study of helminth and protozoan parasites. Life cycles, physiology of parasites, examination of hosts, parasitological techniques. Mr. Bullock. *Prereq.*: Zool. 51 or 151. 2 conf.; 2 lab.; 4 cr. (Alternate years; offered in 1950-51.)

156. INVERTEBRATE ZOOLOGY. A survey of the major invertebrate groups, exclusive of insects, with emphasis on free-living forms. Evolution of various phyla and their ecological relationships. This course will meet with Zoology 56. Students will be expected to do extra reading as well as extra work in the identification of local fauna. The proximity of Durham to salt water gives an excellent opportunity for the study of marine invertebrates in their habitats. Not open to students who have credit for Zool. 56. Mr. Moore. *Prereq.*: 16 hours of Zoology including Zool. 7. 2 lec.; 3 lab.; 5 cr. (Alternate years; offered in 1950-51.)

159. GENERAL PHYSIOLOGY. The chemical and physical nature of the living substance. The processes of metabolism, movement of materials, irritability, response. This course will meet with Zool. 59. Students will be expected to do extra reading and laboratory work. Not open to students who have credit for Zool. 59. Mr. Milne. *Prereq.*: 16 hours of Zoology, a year of college physics, and a course in organic chemistry. 3 lec.; 1 lab.; 4 cr.

160. EXPERIMENTAL PHYSIOLOGY. Laboratory study of aspects of metabolism, movement of materials, irritability and response, with careful consideration of methods, accuracy, interpretation, and presentation of results. A biophysical and biochemical approach to living systems. Mr. Milne. *Prereq.*: Zool. 59 or 159. 2 lec.; 2 lab.; 4 cr.

165. EMBRYOLOGY: A study of the fundamental principles of development. The development process from the egg to the formation of the body and the establishment of the principal organs and systems. This course will meet with Zool. 65. Students will be expected to do extra reading and laboratory work. Not open to students with credit for Zool. 65 or 54. Miss Allen. *Prereq.*: 12 hours of Zoology. 2 lec.; 2 lab.; 4 cr.

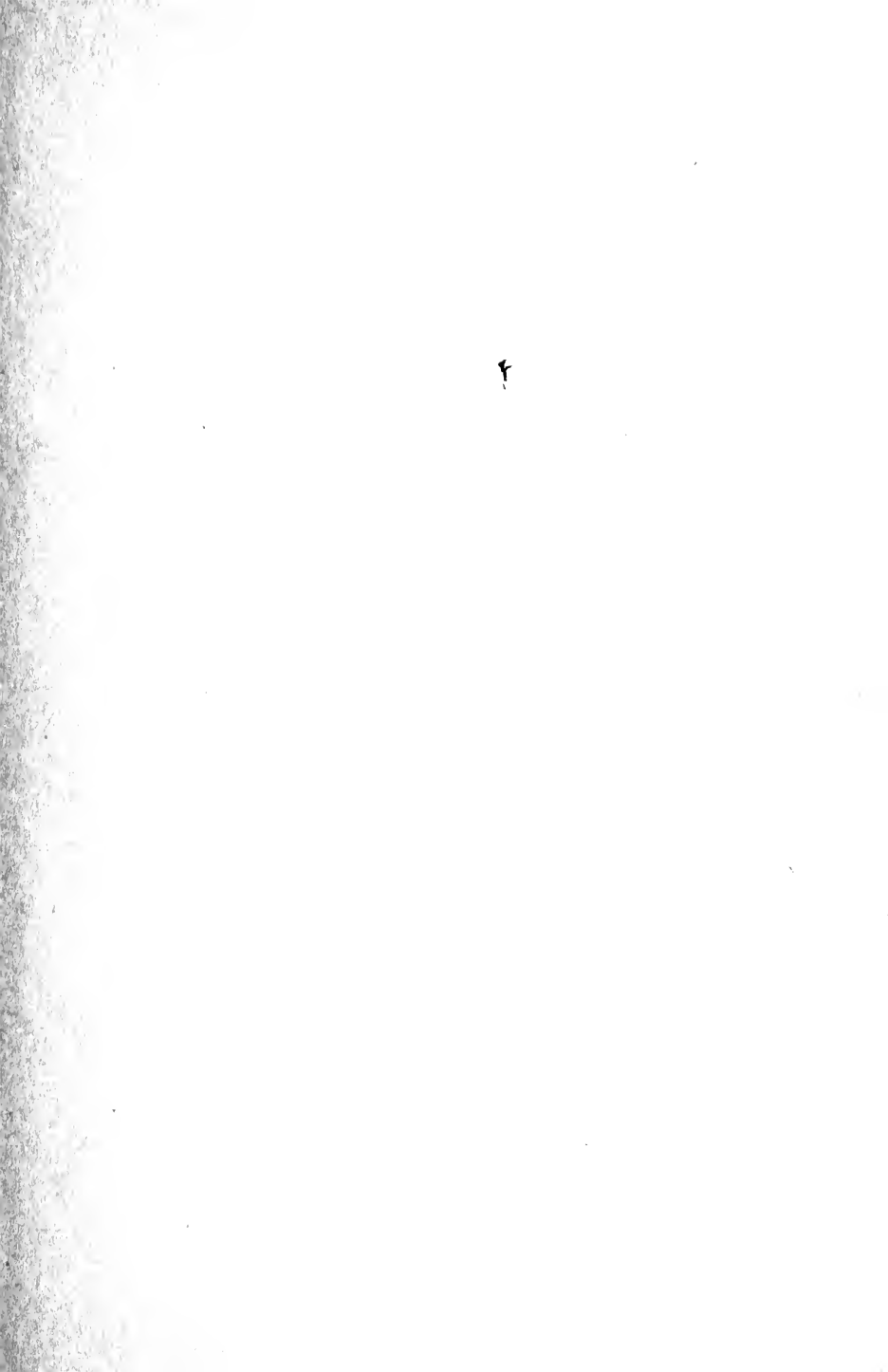
166. HISTOLOGY. This course gives the student a familiarity with the microscopical anatomy of the principal tissues and organs of vertebrates. This course will meet with Zool. 66. Students will be expected to do extra reading and laboratory work. Not open to students who have credit for Zool. 66. Mr. Bullock. *Prereq.*: 14 hours of Zoology. 2 lec.; 2 lab.; 4 cr.

168. PHYSIOLOGY OF DEVELOPMENT. Problems related to fertilization, histogenesis, and organogenesis will be discussed with an emphasis on the experimental approach in both invertebrate and vertebrate groups. Miss Allen. 2 hours seminar. *Prereq.*: Zool 65 or 165. 1 lab.; 3 cr. (Alternate years; not offered in 1950-51.)

171-172. ECOLOGY OF THE VERTEBRATES. A study of the habitat and ecological relationships of the vertebrates with special reference to their conservation. Field methods and techniques as applied to the study of these groups will be considered. This course will meet with Zool. 71-72 and will offer additional work. Not open to students who have credit for Zool. 71-72. Mr. Jackson. *Prereq.*: 24 hours of Biology. 2 lec.; 2 lab.; 4 cr. (Alternate years; offered in 1950-51.)







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